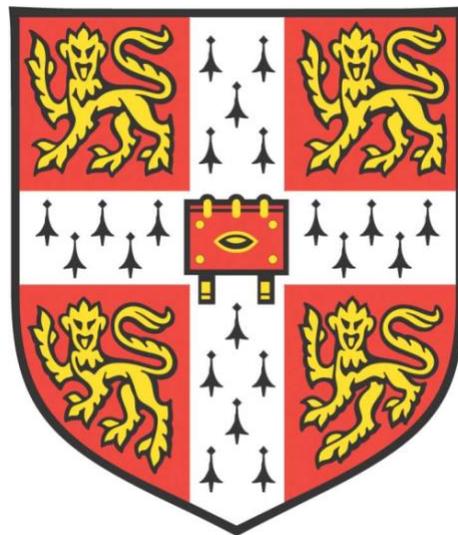


Smart Speaker Use and Psychological Well-Being Among Older Adults



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This dissertation is submitted for the degree of
Master of Philosophy

Declaration

This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration except where specifically indicated in the text. It has not been previously submitted, in part or whole, to any university or institution for a degree, diploma, or other qualification. In accordance with the Department of Psychology guidelines, this thesis does not exceed 20,000 words in length.

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First and foremost, I would like to thank my supervisor, David Good. From the moment I first reached out regarding my application to the University of Cambridge to the moment I officially submitted this dissertation, he has been a constant source of wisdom, encouragement, and inspiration. Over our past year together, he masterfully provided the critical feedback necessary to strengthen the approach and execution of this project, while also affording me the room to think and grow as an independent researcher. For this opportunity, I am deeply grateful. Though our in-person time together was unfortunately cut short, I will always think back on our conversations, often held over tea and biscuits, with fond regard and appreciation.

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Abstract

As the percentage of older adults rises globally, societies are tasked with uncovering solutions to optimally support an aging population. Within this context, a great opportunity lies in investigating how technology can help create a more sustainable and impactful model of senior care by enhancing older adults' psychological well-being.

This dissertation seeks to further our understanding of technology usage outcomes among older adults by studying one novel device in particular: smart speakers. Specifically, semi-structured interviews were conducted with 20 participants to explore if smart speaker usage is associated with psychological well-being among older adults. In order to address gaps in the existing literature, this study employs the Uses and Gratifications theory as a framework through which to examine the participants' sustained smart speaker usage and understand the gratifications that follow from their needs, motives, and behaviors. Drawing on Braun and Clarke's (2006) model of thematic analysis, salient themes are identified and analyzed under the following domains: (1) psychological well-being, (2) gratifications sought, (3) usage behaviors, and (4) gratifications obtained.

This exploratory study contributes to the fields of psychology, gerontology, and gerontechnology by performing foundational work for future research. Namely, it provides rich, contextualized insights about the psychosocial, health, and demographic factors that influence the participants' psychological well-being and motivate their smart speaker usage. Further, its findings suggest that smart speakers offer cognitive, utilitarian, hedonic, and social benefits, which help satisfy the participants' psychological well-being-related needs and desires. Ultimately, these findings hold important implications for smart speakers' potential as an economical resource that can support older adults' well-being.

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Chapter 1: Introduction

1.1 Motivation

The global population of older adults is increasing at a dramatic rate. Typically, “older adults” are considered to be those persons aged 65 and older (World Health Organization [WHO], 2016). According to the United Nations (2019), one in six people in the world will be over the age of 65 by 2050, up from one in eleven in 2019. Nearly every society across the globe is in the midst of this demographic shift, often referred to as population aging, though some countries are experiencing it at a more accelerated rate than others.

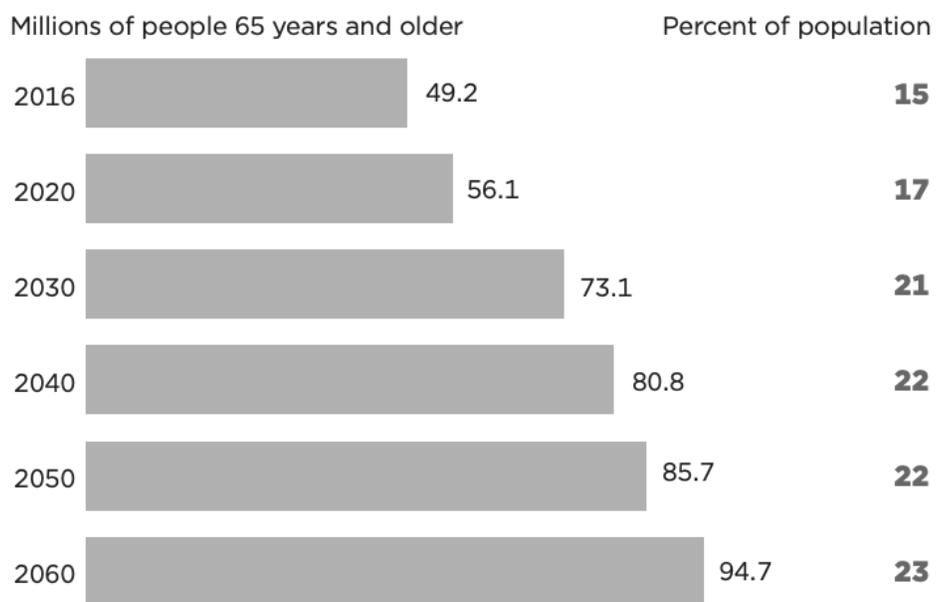
In the United States, the population is already significantly older compared to other parts of the world. The United States Census Bureau (2020) reported that there are slightly over 56 million older adults in the United States, comprising about 17% of the total population. The Census Bureau projected that in 2060, this number will rise to nearly 95 million older adults, or about 23% of the total U.S. population (see Figure 1). This phenomenon is attributed to such factors as better health care, living conditions, and technology (Delello & McWhorter, 2017) in concert with declining fertility rates (United States Census Bureau, 2020).

Though a cause for celebration, the global increase in average life expectancy also presents compelling challenges for modern societies and older adults alike. Longevity is consistently related to higher incidences of adverse physical and psychological conditions, such as chronic diseases, mental illnesses, loneliness, depression, and more (Delello & McWhorter, 2017; Palmarini & Fraser, 2020). Consequently, the effects of this demographic shift include an increased demand for social and healthcare resources, which, if current projections are correct, will not be satisfied (Stevenson, 2018). In response to this dilemma, a growing body of research

suggests an aging population may be best served by efforts focused on maintaining and maximizing older adults’ psychological well-being. Throughout the existing literature, psychological well-being is found to decrease older adults’ need for informal and formal care and increase their quality of life by improving their health, buffering against stressors, and promoting happiness (Cho et al., 2011; Erickson & Johnson, 2011; Robinson et al., 2013). Thus, as the population continues to grow older, it has become essential to understand and implement economical solutions to support older adults’ psychological well-being.

Figure 1

Population of Older Adults in the United States, 2016-2060 (Projected)



Source: United States Census Bureau (2020)

As the population is aging, older adults are also becoming more digitally connected. According to the Pew Research Center, of adults aged 65 and older in the United States, around 53% report owning smartphones and 73% report using the internet (Livingston, 2019a). These percentages can be compared to usage statistics in 2013, when only 18% of older adults owned smartphones and 59% used the internet (Smith, 2014). This expanded usage can be expected to

continue growing exponentially as today's digitally savvy adults age into the older adult demographic.

In response to these concurrent trends, a promising field of research has emerged with the goal of uncovering technological solutions to help support an aging population. The name of this field, gerontechnology, was coined by Graafmans and Brouwers (1989) to describe a framework for investigating opportunities to improve older adults' well-being by combining technological and gerontological research (Bouma, 1992). To date, however, research investigating technology usage outcomes among this demographic has produced mixed results. While many studies report positive outcomes, such as enhanced social connectedness, life satisfaction, and self-efficacy (Delello & McWhorter, 2017; Erickson & Johnson, 2011; Hutto et al., 2015; Shapira et al., 2007), some have failed to find any relationship between technology usage and well-being in later life (Slegers et al., 2008; White et al., 2002), and others suggest negative outcomes that may arise (Vaportzis et al., 2017; Wilson, 2018). These diverse findings indicate important avenues of research, especially with regard to nascent technologies.

In recent years, smart speakers have begun attracting attention due to the potential they may hold for older adults. Specifically, studies and pilot adoption programs have found that smart speakers' voice-activated personal assistants offer a natural and easily adoptable interface for older adults and can help promote their independence, safety, social connectedness, and more (Elza et al., 2019; Kowalski et al., 2019; Mizak et al., 2017; O'Brien et al., 2019; Peifer, 2019; Stone, 2018). While these findings suggest that smart speaker usage may have a positive effect on factors that influence older adults' psychological well-being, research in this field is still limited. Among the studies that do exist, none have moved past older adults' initial experiences with smart speakers in order to investigate their sustained usage behaviors and outcomes, as well

as the underlying factors motivating and influencing their usage. This project seeks to extend previous work to further develop our limited understanding in these domains and, more broadly, to explore whether smart speakers offer promise as a beneficial resource for an aging population.

1.2 Overview and Contributions

In response to the trends and opportunities detailed in the preceding section, this dissertation aims to explore if smart speaker usage is associated with psychological well-being among older adults. Further, it aims to address gaps in the existing literature by examining older adults' sustained smart speaker usage motives, behaviors, and outcomes. To meet these aims, semi-structured interviews were conducted with 20 older adults who have owned smart speaker devices for at least six months, and the Uses and Gratifications theory is used as a framework through which to analyze the study's data and structure its findings. Through thematic analysis of the interview transcripts, this exploratory research uncovers central themes related to the participants' experiences with psychological well-being and smart speaker usage in later life.

Overall, this dissertation offers three notable contributions. First, it builds upon and expands Uses and Gratifications research by applying the theory to a novel device and investigating its usage among older adults. Second, it contributes to psychology and gerontology research by identifying key factors that influence the participants' psychological well-being. Third, it advances gerontechnology research by exploring the potential for smart speakers to support well-being among older adults. In doing so, this project provides foundational work for future research.

In addition to these contributions, this dissertation holds important implications. Namely, its findings suggest that smart speakers may serve as an economical resource that can help

sustainably support and even enhance key determinants of older adults' psychological well-being. By supporting older adults' well-being, the devices may also help relieve pressure on healthcare and social resources. As such, this research presents an opportunity for senior living communities, caregivers, family members, charities, and nonprofit organizations, to name a few, to promote smart speakers' distribution and adoption among a greater number of older adults.

To further contextualize this research, the following chapter reviews relevant external literature. This literature helps frame the study's methodological approach, which is presented in Chapter 3. Then, findings from the data analysis are discussed in Chapter 4. Finally, Chapter 5 concludes the dissertation by summarizing its findings, recommending directions for future work, and elaborating on the contributions and implications of the research as a whole.

Chapter 2: Literature Review

2.1 Overview

The literature review presented in this chapter situates the present study in relation to existing research and theories. In order to contextualize the dissertation's primary research question, aims, and objectives, which are more rigorously defined in Chapter 3, the following central topics are addressed: psychological well-being, technology usage outcomes, and smart speaker usage in later life. Further, the review identifies specific gaps in the existing literature that motivate the study's purpose and design.

2.2 Well-Being in Later Life

Population aging has emphasized the importance of research investigating well-being in later life. This field of research has a rich history, over the course of which scholars have attempted to conceptualize what constitutes "successful aging." In early literature, older adults were largely regarded as a homogenous group, and aging was primarily examined and evaluated through a biological lens (Rowe & Kahn, 1987). Two decades after the term successful aging was first coined, Rowe and Kahn (1987) helped shift the discourse to a more comprehensive understanding of well-being by highlighting the important impact extrinsic factors and mental states have on the aging process. Jeste et al. (2010) further advanced the field by identifying a tension present in the literature; they recognized that while most older adults were not considered to be aging successfully by objective criteria, such as those based on physical health, these same older adults were considered to be aging successfully by subjective criteria, such as those based

on psychosocial factors. These refined evaluations helped establish the importance of psychological well-being to the study and experience of wellness among older adults.

Like successful aging, the understanding and assessment of psychological well-being has evolved over time. Taking a hedonic approach, which emphasized the presence of positive affect and the absence of negative affect, early research usually posed a single question about happiness or life satisfaction to evaluate one's psychological well-being. In another camp, research assumed an eudaimonic approach, evaluating psychological well-being based on the extent life is lived in a full and deeply satisfying way (Deci & Ryan, 2008). From these two traditions, research on psychological well-being has since evolved into a much more complex evaluation of varied combinations of psychosocial, health, and demographic factors (Diener et al., 2009). As Ryff and Singer (2008, p.14) put it, well-being is "profoundly influenced by the surrounding contexts of people's lives."

2.2.1 Psychosocial Factors

While definitions and models of psychological well-being still vary within the existing literature, common psychosocial elements tend to emerge. These recurring elements include a general satisfaction with oneself and one's life, a sense of personal growth, the presence of positive interpersonal relationships, a perceived ability to meet the personal demands of and control one's environment, and a high occurrence of positive emotional states (Erickson & Johnson, 2011; Ryff, 1995). Demonstrating this, studies have found that such variables as life satisfaction (Diener, 1984; Forsyth et al., 1992), social support (Jang et al., 2002; Litwin, 2001), and environmental mastery (Jang et al., 2002; Lachman et al., 2009; Rowe & Kahn, 1997; Ryff, 1995) are positively related to psychological well-being. Conversely, variables like loneliness

(Aylaz et al., 2012; Cacioppo & Cacioppo, 2014; Coyle & Dugan, 2012), social isolation (Coyle & Dugan, 2012; Holt-Lunstad et al., 2015; Holt-Lunstad et al., 2010), and depression (Fiske et al., 2009; Schonfeld et al., 1997) are found to be negatively related to psychological well-being.

For older adults, these psychosocial variables can be negatively impacted by numerous health and demographic factors, such as physical impairments and living alone (see sections 2.2.2 and 2.2.3). However, studies have found that psychosocial resources can also serve as buffers that attenuate adverse effects from these very factors. For example, among a sample of community-dwelling older adults, environmental mastery and social resources were found to buffer against the depression that typically arises in the face of declining health (Jang et al., 2002). This moderating relationship underscores the importance of efforts to support the development and maintenance of positive psychosocial environments for older adults in order to enhance their overall psychological well-being.

2.2.2 Physical Well-Being

Though distinct concepts with varied determinants, research has established a positive relationship between physical and psychological well-being. In one direction, lower levels of physical well-being, based on both subjective and objective measures, are found to have adverse effects on psychological well-being (Cho et al., 2011). Exemplifying this, disability is a widely acknowledged risk factor for depression in later life (Jang et al., 2002; Kennedy et al., 1990), and visual and hearing impairments can lead to an increase in social isolation and loneliness (Palmarini & Fraser, 2020). In the reciprocal direction, research indicates that higher levels of loneliness can lead to an increased risk for dementia (Wilson et al., 2007), functional limitations (Luo et al., 2012), and cardiovascular disease (Olsen et al., 1991). Furthermore, social isolation

is found to have a mortality risk similar to that of heavy smoking and exceeds many well-known risk factors for mortality, such as obesity and physical inactivity (Holt-Lunstad et al., 2010). The correlated nature of physical and psychological well-being can be especially problematic for older adults, who experience heightened incidences of losing loved ones, living alone, developing sensory impairments, and managing physical and cognitive disabilities, among other factors.

2.2.3 Demographic Variables

Like psychosocial and health factors, demographic variables can also play an important role in one's psychological well-being. Specifically, age, race, sex, income, marital status, education level, and employment status have been associated with well-being throughout the existing literature (George, 2010; Hawkey et al., 2017; Larson, 1978; Palmore, 1981).

Among older adults, marital status and living arrangement have an especially significant effect. Studies have found that older adults who are divorced, separated, or widowed are more likely to be lonely than those who are married (Hawkey et al., 2017). Non-married older adults frequently live alone, which is also related to a higher risk for loneliness and social isolation (Stepler, 2016). According to the Pew Research Center, about 23% of American adults aged 60 and older live alone, totaling to 16.7 million people (Livingston, 2019b). A national poll on healthy aging in the United States found that among older respondents living alone, 60% reported feeling a lack of companionship and 41% reported feeling isolated (Malani et al., 2019). These findings are significant because, as reviewed, research has consistently indicated that loneliness and social isolation can pose a substantial threat to one's psychological and physical well-being (Aylaz et al., 2012; Cacioppo & Cacioppo, 2014; Coyle & Dugan, 2012; Holt-

Lunstad et al., 2015; Holt-Lunstad et al., 2010). In response to the growing number of older adults experiencing these negative effects, researchers have begun investigating the potential for technology to foster social connections and support, along with other key determinants of their psychological well-being. Examples of this important work are reviewed in the following section.

2.3 Technology Usage Outcomes Among Older Adults

In recent years, a substantial body of research investigating older adults' technology usage has emerged. While many studies focus on technology specifically designed for seniors, others have sought to understand the impact mainstream technology has on older adults' lives. Among this latter body of work, a promising number of studies suggest a positive relationship between technology usage and psychological well-being.

Though health and demographic variables are usually accounted for in their data analyses, studies exploring technology's impact on older adults' well-being typically focus their investigations on the mediating role of psychosocial variables. For example, both observational and experimental studies examining older adults' use of internet-connected devices, such as cell phones, iPads, and computers, have found positive correlations between usage and life satisfaction, self-efficacy, self-worth, social support, and environmental mastery and negative correlations between usage and loneliness and depression (Delello & McWhorter, 2017; Erickson & Johnson, 2011; Shapira et al., 2007; Wilson, 2018). Likewise, research has found that older adults who use social networking services report reduced loneliness and greater social connectedness compared to those who do not (Hutto et al., 2015; Yu et al., 2016). These studies,

among many others, suggest that everyday technologies can influence critical psychosocial determinants of older adults' psychological well-being.

Notably, some studies have failed to find any relationship between technology usage and psychological well-being in later life (Slegers et al., 2008; White et al., 2002), and others have identified adverse outcomes that may arise from technology use. For example, a study exploring the impact of everyday digital technology use on older adults' well-being found a negative relationship between older adults' emotional attachment towards a technological device and their sense of belonging, suggesting a risk that might arise from an overdependence on technology (Wilson, 2018). Further, it was found that attempts to use new technology can lead older adults to experience feelings of inadequacy (Vaportzis et al., 2017). Due to these diverse findings, the study of technology usage outcomes among older adults remains a prevailing and important avenue of research.

2.4 Promoting Smart Speakers in Senior Living Facilities

Senior living organizations have started to recognize the potential information and communications technology (ICT) and assistive technology (AT) may hold for their residents. Falling within both of these categories, smart speakers, in particular, have drawn attention due to their voice-first functionality and low price point. These devices contain integrated voice assistants, also referred to as virtual assistants or voice-activated personal assistants, that allow users to perform tasks through voice commands or questions. Research shows that voice assistants, such as Amazon's Alexa, Google's Assistant, Microsoft's Cortana, and Apple's Siri, are changing the way people complete tasks and are increasingly becoming incorporated into their everyday lives (Kinsella, 2019; McLean & Osei-Frimpong, 2019).

Since their inception in 2014, smart speakers have seen extraordinary growth. According to a survey conducted by NPR and Edison Research (2020), the number of smart speakers in U.S. households grew 135% between 2017 and 2019, outpacing smartphone and tablet computer adoption trends. In total, around 24% of U.S. adults aged 18 or older own a smart speaker, which typically costs between \$30 and \$130. While smart speakers are a large and growing market, only about 19% of users are aged 65 and older (Auxier, 2019). However, older adults represent a demographic that could potentially serve to benefit the most from this innovative technology.

Smart speakers offer especially promising applications for older adults for numerous reasons. To start, voice-first technology allows for a more natural, intuitive form of interaction that eliminates some of the barriers older adults face with other devices, such as reading small text, typing, or navigating touch-screen interfaces (Ziman & Walsh, 2018). Smart speakers can also control Internet of Things-enabled devices such as lights, thermostats, and televisions to achieve what is referred to as home automation. By linking these devices, older adults can more easily, safely, and independently control their home environments (Mizak et al., 2017). This feature, along with the voice-first nature of the technology in general, is particularly well suited for older adults with visual and physical impairments.

Smart speakers can also add other features, often called skills, that augment their ability to fit the exact needs of their users (Hoy, 2018). Many third-party developers have started to offer skills designed specifically with older adults in mind. For example, through Touchtown's "My Community" skill, users can ask their smart speaker about specific information pertaining to the senior living residence they live in, such as what activities are going on that day. This skill offers the potential to enhance social connectedness and mitigate loneliness among residents. As health and safety are top-of-mind concerns for older adults and their caregivers, several

developers have produced skills that allow users to send help alerts, inform their loved ones they are okay, and receive proactive voice prompts with health and wellness reminders (Rieland, 2018). These skills can help support older adults' physical well-being and buffer against health-related stressors. In light of these offerings, a growing number of senior living organizations across the United States have started piloting smart speaker integration programs to learn how the devices can improve their residents' well-being and, in turn, help lessen their caregivers' daily load.

2.5 Investigating Older Adults' Smart Speaker Usage

Though most smart speaker adoption programs are in their infancy, the initial reactions and outcomes have been encouraging. In 2017, the Front Porch Center for Innovation and Wellbeing (FPCIW) launched one of the first and most expansive of these programs with Amazon Echo devices. FPCIW is part of Front Porch, a nonprofit organization that owns and oversees 12 senior living communities in the United States. FPCIW developed this program with the goal of better understanding how voice assistants and home automation technology may help promote greater convenience, independence, and overall well-being for older adults. At the end of a six-month pilot program within one of their communities, surveys collected from 11 of the program's participants revealed high satisfaction rates: 75% used their smart speaker devices at least once a day and 100% felt the devices made their life easier. Post-pilot interviews helped elucidate why the technology was received with such enthusiasm. In particular, the participants cited smart speakers' ability to enhance their independence and self-management within the home as key reasons for their positive reception of the devices (Mizak et al., 2017).

Preliminary observations from similar programs further suggest the potential smart speakers may hold for older adults' daily lives and their psychological well-being. Interviews with the programs' overseers and participants reveal the devices have helped older adults feel more comfortable, independent, and safe around the home, enhanced their social connectedness and convenience, decreased their sense of loneliness, and provided them with enjoyment (Elza et al., 2019; Peifer, 2019; Stone, 2018). Additionally, smart speakers' entrance into senior living communities has been found to improve staff productivity. By serving as a resource that assists residents retrieve information and complete tasks, they have helped free up staff time that was previously devoted to such matters (Stone, 2018). This finding is supported by a study that examined Amazon Echo reviews posted online, which found that the devices help alleviate caregiver burden by offsetting some of the tasks typically performed for older adults (O'Brien et al., 2019). Altogether, these programs indicate that older adults are willing to adopt smart speakers and demonstrate positive benefits the devices can provide.

Despite smart speakers' increasing prevalence, research investigating their usage by older adults is still limited. While there are a variety of related literatures examining smart speaker use among younger demographics and older adults' experiences with voice-first and assistive technologies, only a handful of studies look specifically at older adults' use of smart speakers. Among the few studies that do exist, researchers have typically examined older adults' usage experiences, behaviors, and barriers (Hanley & Azenkot, 2018; Kowalski et al., 2019; O'Brien et al., 2019; Puro & Meng, 2019). Table 1 provides an overview of the existing studies and their findings. These studies emerged from a thorough search of Web of Science, Google Scholar, and JSTOR using combinations of key terms such as "Amazon Alexa," "smart speakers," "voice assistants," and "older adults."

Table 1*Existing Studies on Older Adults' Smart Speaker Usage*

Study	Aim(s)	Device	Methodology	Findings
Understanding the Use of Voice Assistants by Older Adults (Hanley & Azenkot, 2018)	Better understand the ways in which older adults engage with and learn how to use smart speakers	Amazon smart speakers	Semi-structured phone interviews (n=4)	Usage trends: assistive technology and social interaction Usage prerequisite: formal training considered helpful
Older Adults and Voice Interaction: A Pilot Study with Google Home (Kowalski et al., 2019)	Research older adults' interaction with voice user interfaces combined with smart home technology	Google Home	Semi-structured focus groups (n=7)	Usage experience: enjoy the device's intuitive, voice-first functionality and find the voice assistant friendly, helpful, and easy to incorporate into everyday life Usage barriers: need to have compatible devices for home automation and difficult to find new skills
Voice-Controlled Intelligent Personal Assistants to Support Aging in Place (O'Brien et al., 2019)	Obtain an initial understanding of how this type of technology might be implemented in the home of an older adult	Amazon Echo	Retrospective review of purchase reviews posted on Amazon.com with filtering for health-related older adult keywords (n=125)	Usage trends: entertainment, companionship, home control, reminders, and emergency communication Usage barriers: misunderstood commands and inadequate responses
Data Capture and Analyses from Conversational Devices in the Homes of the Elderly (Purao & Meng, 2019)	Describe usage patterns and problems related to the use of conversational devices at home by the elderly	Amazon Echo	Data scrape from device usage history over 6-month period (n=8)	Usage trends: the majority of interactions were single commands as opposed to conversational exchanges Usage barrier: misunderstood commands

Like the pilot adoption programs, these studies begin to elucidate how older adults perceive and use smart speakers. However, the existing research neglects to investigate the

following: (1) sustained usage trends, (2) usage outcomes, and (3) underlying variables that motivate and influence usage. As such, there exists a need for novel research to address these gaps in order to grow our understanding of smart speakers' ability to support psychological well-being among older adults.

2.5.1 Uses and Gratifications Theory

In consideration of the identified research opportunities, the Uses and Gratifications (U&G) theory presents a well-suited framework for studying older adults' smart speaker usage. Throughout gerontechnology research and, more broadly, studies examining human-computer interaction (HCI), the U&G theory has become a commonly used approach to investigate technology usage. Dating back to the 1940s, U&G was initially developed as a theoretical motivational paradigm to examine individuals' media usage, and it was applied towards such mediums as newspapers and the radio. The principal elements of U&G include users' psychological and social environments, the gratifications they seek from the media in question, their media usage behaviors, and the gratifications obtained from their usage behaviors (Rubin, 2008). Notably, the theory is based on the assumption that people actively select the media they do in order to fulfill specific needs and desires, which are shaped by their psychological and social environments (Katz, Blumler, & Gurevitch, 1973). As succinctly summarized by Katz et al. (1974), U&G's objectives are to explain how people use media to gratify their needs, to understand their motives for media behavior, and to identify outcomes that follow from users' needs, motives, and behaviors.

Today, U&G is leveraged as a prominent theoretical framework for examining the adoption and use of contemporary technologies. The theory has been used to investigate

individuals' use of television (Palmgreen & Rayburn, 1979; Palmgreen et al., 1980), social media (Kong & Lee, 2017; Papacharissi & Mendelson, 2011; Quan-Haase & Young, 2010), tablet computers (Magsamen-Conrad et al., 2015), mobile phones (Wang et al., 2018), the internet (Aytuna & Çapraz, 2018; Ivan & Fernández-Ardèvol, 2017), digital music technologies (Mao & Good, 2018), and more. Relevantly, it has also been implemented as a lens through which to study smart speaker usage (McLean & Osei-Frimpong, 2019).

In order to successfully apply the U&G approach, studies must address the following in their design and analysis: (1) users' needs and desires, as shaped by their psychological and social environments, (2) the gratifications users seek from the technology in question, (3) users' technology usage behaviors, and (4) the gratifications users obtain from using the technology in question. U&G research must also take the important step of drawing connections between these four principal elements in order to understand people's motives for and benefits from using technology (Katz, Blumler, & Gurevitch, 1973; Rubin, 2008). Though some researchers choose to apply alternative frameworks to their technology studies, such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), the U&G theory provides a particularly unique and appealing approach that aligns with this project's aims due to its focus on the social and psychological antecedents of and gratifications obtained from technology usage.

To date, many existing studies that claim to adopt the U&G approach have focused solely on users' sought gratifications (Katz, Blumler, & Gurevitch, 1973; Palmgreen & Rayburn, 1979). This is exemplified by McLean and Osei-Frimpong's (2019) work, which aimed to investigate young and middle-aged adults' smart speaker usage. While the researchers did identify specific perceived benefits that were found to motivate the device's adoption and usage, they failed to

investigate the variables driving the desire for these benefits, the types of usage behaviors used in an effort to obtain them, and whether or not they were received through usage of the device. In order to better understand people's technology usage and the benefits technology can offer, as this study hopes to do, well-conducted U&G research must address and connect each element of the framework.

2.6 Summary

This literature review provides important context for the study's purpose and design. By reviewing existing research on psychological well-being and technology usage in later life, it identifies an opportunity to apply this knowledge to a novel device that has yet to be thoroughly investigated: smart speakers. Specifically, this dissertation seeks to extend previous work by using the U&G theory to explore smart speakers' potential to support older adults' psychological well-being. The methodological approach adopted for this purpose is outlined in the following chapter.

Chapter 3: Methodology

3.1 Overview

A detailed account of the dissertation's methods is presented in this chapter. First, the study's aims, objectives, and primary research question are identified, as they serve as the foundation for the methodology. Next, a thorough overview of the study's research design is provided, including rationale for the methods that were selected for the data's collection and analysis. Lastly, the quality, value, and possible limitations of the research are discussed.

3.2 Research Aims and Objectives

In consideration of the trends, theories, and literature reviewed in the preceding chapters, this dissertation seeks to advance the limited body of research studying smart speaker usage among older adults. Namely, it aims to explore if smart speaker usage is associated with psychological well-being among older adults. Further, it aims to address gaps in the existing literature by looking specifically at older adults' sustained smart speaker usage experiences. Both of these aims are important to developing our understanding of smart speakers' potential to serve as a resource that can support psychological well-being in later life. To meet these aims, the objective of this research is threefold:

1. Investigate the variables that influence older adults' psychological well-being.
2. Examine older adults' sustained smart speaker usage motives, behaviors, and outcomes through the U&G approach.
3. Explore whether any relationships exist between older adults' smart speaker usage and their psychological well-being.

By meeting these objectives, this project hopes to serve as the inspiration and foundation for future research that examines these topics further and to contribute to the body of literature

studying technology's impact on well-being in later life. What follows is the research design used to answer the main research question: What are older adults' experiences with psychological well-being and smart speakers, and how may the two be connected?

3.3 Research Design

Due to its exploratory nature, this study employed a qualitative approach. Qualitative methods allow for the collection and analysis of rich data emphasizing people's "lived experiences" in order to locate the meaning they place on the "events, processes, and structures of their lives" (Miles & Huberman, 1994, p. 10). As well-being is a complex construct that typically varies based on context, interviews were conducted to gain a firsthand understanding of the participants' own conceptualizations of and experiences with psychological well-being in later life.

Qualitative methods are also useful when studies hope to supplement existing research, study new topic areas, and develop hypotheses for further testing (Miles & Huberman, 1994). Thus, a qualitative approach was also well suited for this project's goals of extending previous work, exploring themes that have yet to be addressed in the extant literature, and providing foundational work for future studies. Specifically, semi-structured, in-depth interviews and thematic analysis were employed to gain a more comprehensive understanding of older adults' motivations for using, ways of using, attitudes towards, and gratifications obtained from smart speakers.

Taken together, this study consisted of three primary phases. First, a literature review was performed to identify meaningful opportunities and gaps in the existing research. Second, interviews were designed and conducted to explore key topics related to the study's aims and

objectives. Third, thematic analysis was employed to uncover prominent themes in the data for discussion and analysis.

3.3.1 Ontological and Epistemological Position

Ontological considerations raise questions about the nature of social phenomena and “whether the social world should be viewed as something that is external to social actors and over which they have no control” (Bryman, 2012, p. 6). Qualitative research often assumes an ontological position of constructionism, which “examines the ways in which events, realities, meanings, experiences, and so on are the effects of a range of discourses operating within society” (Braun & Clarke, 2006, p. 81) and “asserts that social phenomena and their meanings are continually being accomplished by social actors” (Bryman, 2012, p. 6). In seeking to understand older adults’ subjective perspectives on well-being and experiences with smart speakers, this study is grounded in a constructionist paradigm. As such, it recognizes that each participant will have a unique way of portraying his or her perceptions and experiences to the researcher.

Epistemological considerations raise questions about how the social world should be studied. Qualitative research often assumes an epistemological orientation of interpretivism, which “requires the social scientist to grasp the subjective meaning of social action” (Bryman, 2012, p. 31). Thus, an interpretivist approach involves double interpretation, wherein the researcher provides an interpretation of others’ interpretations. In order to examine and provide analyses on the underlying ideas and perceptions that are theorized to shape the semantic content of the data, this study is grounded in an interpretivist paradigm (Braun & Clarke, 2006).

When conducting qualitative research, it is also important to consider researcher positionality. In recent years, the term constructionism has come to include the notion that “researchers' own accounts of the social world are constructions” (Bryman, 2012, p. 33). In other words, the researcher’s analysis should be regarded as a specific version of reality, rather than a definitive account (Bryman, 2012). Therefore, as this project’s sole researcher, I acknowledge that I will have my own way of constructing meaning from the information relayed to me in the interviews and that the findings presented in Chapter 4 are my own interpretations.

3.4 Methods of Data Collection

Identifying and recruiting suitable participants can be one of the greatest challenges of qualitative research. In order to locate and access older adults who have used smart speakers for a prolonged period of time, this project utilized a purposive sampling strategy. Purposive sampling was necessary in part due to resource and timing constraints, but it also allowed for the strategic selection of participants who were both relevant to the research objectives and illustrative of specific cases, which were included to enhance the breadth of analysis (Bryman, 2012). Additionally, this sampling strategy helped mitigate variances among the participants, such as socioeconomic status and exposure to smart speaker training resources.

After conducting a comprehensive review of the existing programs and organizations that have been integrating smart speakers into senior living communities, a program manager at Front Porch was enlisted to gain access to the field. As initially introduced in the literature review (see section 2.5), Front Porch has been a pioneer in developing and implementing smart speaker programs within their senior living residences in the United States. To date, they have provided Amazon smart speaker devices to over 400 residents across their communities. Using a

gatekeeper who was well known and respected by the communities' residents not only enabled access to a wide range of prospective participants, but it also helped establish a level of trust between the researcher and the participants going into the interviews (Silverman, 2015).

After conducting an initial call with the program manager to explain the goals of the research, she worked with several of Front Porch's communities to arrange interviews with residents. As relayed in the call, the residents selected for this study had to meet the following criteria: (1) participated in their community's smart speaker program, (2) owned a smart speaker for at least six months, and (3) reside in independent living arrangements within their senior living community.

The first criterion was set to control for the participants' smart speaker training experiences, as training is found to be an influential variable of older adults' successful adoption and use of new technologies (Charness & Boot, 2009; Hanley & Azenkot, 2018; Smith, 2014). The second criterion aligns with the study's aim of addressing gaps in the existing literature by looking at older adults' sustained smart speaker usage. To date, no other studies have examined older adults' usage of the devices beyond six months of ownership. Finally, the third criterion was set to help further diminish variances among the participants. While it is important to explore and understand the benefits smart speakers may provide to all older adults, like those residing in memory care or assisted living arrangements, such inquiry extends beyond the scope of this project. However, residents with hearing, visual, and physical impairments were included in an effort to enhance the breadth of analysis.

No restrictions were placed on the participants' age, gender, race, employment status, or marital status, but all participants were White, retired, and at least 65 years old ($\bar{x} = 82.2$), placing them within the "older adult" category (WHO, 2016). Ultimately, this sampling strategy

helped recruit 20 residents (65% female, 35% male) from five of Front Porch’s senior living communities, the details of which are depicted in Table 2 and Table 3.

Table 2

Demographics of Interview Participants

P#	Gender	Age	Front Porch Community	Marital Status	Living Arrangement	Health Impairments
1	Female	80	Casa de Mañana	Widowed	Alone	None
2	Female	70	Casa de Mañana	Single	Alone	Blind
3	Female	80	Casa de Mañana	Widowed	Alone	None
4	Male	97	Casa de Mañana	Married	With wife	Blind, hearing
5	Male	81	Carlsbad by the Sea	Married	With wife	None
6	Female	78	Walnut Village	Married	With husband (P7)	Mobility
7	Male	79	Walnut Village	Married	With wife (P6)	Mobility, hearing
8	Female	91	Walnut Village	Widowed	Alone	Breathing, mobility
9	Male	71	Walnut Village	Married	With wife	None
10	Male	75	Walnut Village	Married	Alone (wife in memory care unit)	None
11	Female	83	Walnut Village	Widowed	Alone	Mobility
12	Female	88	Villa Gardens	Divorced	Alone	Hearing, vision
13	Female	92	Villa Gardens	Widowed	Alone	Vision, balance, mobility
14	Female	90	Villa Gardens	Married	Alone (husband in memory care unit)	Hearing
15	Female	82	Villa Gardens	Widowed	Alone (with dog)	None
16	Female	83	Kingsley Manor	Widowed	Alone	Blind
17	Female	84	Kingsley Manor	Married	With husband (P18)	None
18	Male	74	Kingsley Manor	Married	With wife (P17)	None
19	Female	77	Kingsley Manor	Married	With husband (P20)	None
20	Male	89	Kingsley Manor	Married	With wife (P19)	Memory, mobility

Table 3*Overview of Front Porch Communities Included in the Sample*

Name	Location	Description	Smart Speaker Program
Casa de Mañana	La Jolla, CA	Retirement community with 190 private independent residences and assisted living services	Launched May 2018 with Amazon smart speaker devices and home automation accessories (Echo Dot, Echo, and smart plug)
Carlsbad by the Sea	Carlsbad, CA	Retirement community with 160 private independent residences, assisted living services, and a care center	Launched February 2017 with Amazon smart speaker devices and home automation accessories (Echo Dot, Echo Plus, and smart plug)
Walnut Village	Anaheim, CA	Retirement community with 156 private independent residences, assisted living services, and a memory care unit	Launched June 2018 with Amazon smart speaker devices and home automation accessories (Echo Dot, Echo, smart plug, and smart light bulb)
Villa Gardens	Pasadena, CA	Retirement community with 195 private independent residences, assisted living services, a care center, and a memory care unit	Launched April 2019 with Amazon smart speaker devices and home automation accessories (Echo Plus and smart light bulb)
Kingsley Manor	Los Angeles, CA	Retirement community with 223 private independent residences, assisted living services, and a care center	Launched May 2019 with Amazon smart speaker devices and home automation accessories (Echo Plus and smart light bulb)

Ahead of the interviews, an interview guide was created to maximize the quality of the data (see Appendix A). Interview guides help ensure critical research themes are addressed during the interview, but they also allow the interviewee a great deal of leeway in how to reply (Bryman, 2016). The topics and questions included in the interview guide were adapted from existing research examining successful aging, well-being, and technology usage. Topic headings included: Perceptions and Experiences of Well-Being in Later Life, Initial Motivations for Using and Experiences with Smart Speakers, Sustained Smart Speaker Usage Motives and Behaviors,

and Gratifications/Outcomes from Using Smart Speakers. As is customary with semi-structured interviews, the topics and questions in this guide were memorized prior to the interviews and merely served as a reference point, as opposed to a verbatim script. Further, a pilot interview was conducted to help familiarize the researcher with the guide and determine where adjustments were needed.

Primary data collection for this project was conducted in California, where the majority of Front Porch's communities are located. Ten face-to-face interviews were conducted privately within residents' homes or common spaces at their communities. Due to unforeseen scheduling conflicts and the distant locality of two of the communities included in the sample, the remaining seven interviews were conducted over the phone. In three instances, couples were interviewed together. Paired interviews allow for thick descriptions about participants' individual and shared experiences, but they may also result in one participant dominating the conversation (Wilson et al., 2016). Thus, a conscious effort was made to ensure both participants were able to answer each question. Further, great care was taken during data analysis to treat each husband and wife as individual participants, as opposed to a unit.

After receiving permission from the participants, each interview was audio recorded. During the interviews, the order and wording of the questions included in the interview guide varied to encourage a more natural and comfortable conversational flow, and additional questions were asked in order to gain clarification or glean more information from the participants as needed. The interviews ranged from 12 to 78 minutes in length, with the majority of interviews lasting between 30 to 45 minutes. To thank each participant for his or her time, small, non-monetary gifts were provided at the end of each interview.

3.4.1 Ethical Considerations

This study received ethical approval from the Department of Psychology Research Ethics Committee at the University of Cambridge. Before each interview, the participants were provided with information sheets (see Appendix B) and consent forms (see Appendix C) to review and approve. Thus, informed consent was received for each participant. At the start of each interview, the participants were encouraged to ask questions about the study and were reminded that they were free to withdraw at any time. During each interview, the participants were not asked to reveal any sensitive or intimate information, nor were they put at risk of any psychological stress. After each interview, the participants were handed or sent debrief forms (see Appendix D) and were again encouraged to ask questions. No deception was involved at any point throughout this process.

Following data collection, several steps were taken to ensure secure data storage and participant confidentiality. The data obtained from the interviews, in the form of audio recordings and transcripts, was stored on the primary researcher's private, password-protected laptop and backed up on a private and secure external hard drive. During transcription, which was carried out in a private space, the participants' names were replaced with identification numbers. Furthermore, while writing up this dissertation, great care was taken to ensure no confidential or identifiable information was included for any of the participants. In alignment with the University of Cambridge's Policy Framework on Research Data Management, the anonymized data was shared with Front Porch in order to increase the transparency and reusability of the research.

3.5 Data Analysis

The data analysis for this study follows the process of thematic analysis in psychological research established by Braun and Clarke (2006) and takes a theoretical approach, as proposed by Joffe and Yardley (2004). In qualitative research, thematic analysis is a popular method for “identifying, analyzing, and reporting patterns (themes) within data” (Braun & Clarke, 2006, p. 79). According to Braun and Clarke (2006), thematic analysis can be broken down into six key phases: (1) familiarizing oneself with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report.

Based on these guidelines, phase one of thematic analysis consists of verbatim transcription, reading and re-reading the data, and noting down initial ideas. Following this model, the interview recordings were transcribed verbatim, systematically leveraging transcription symbols from Atkinson and Heritage (1984). During the transcription process, analytic memos were written in a research diary (see Appendix E) to keep track of information about the participants and document emergent codes and patterns. This memo writing continued during subsequent readings and re-readings of the transcripts.

In alignment with its objectives, this project leveraged theories, concepts, and findings from prominent successful aging, psychological well-being, and U&G scholars to analyze and interpret the data. In other words, a theoretical, or top-down, approach to thematic analyses was implemented. According to Joffe and Yardley (2004), this approach provides “systematic analysis of the meanings made of the phenomena under investigation” (p. 63) and lets existing theories “drive the questions one asks and one’s understanding of the answers, so that one does not ‘reinvent the wheel’” (p. 57). Further, it allows the researcher to code for a specific research question and was thus well suited for this study. Adopting this method shaped the subsequent

phases of thematic analysis, which entailed cycles of coding, collating, and theming the data in a recursive and systematic fashion (Braun & Clarke, 2006).

After the interview recordings were transcribed, multiple cycles of coding were conducted in order to look for patterns throughout the data. First cycle methods consisted of Initial, Structural, Provisional, and Attribute Coding. Next, the data was reviewed with second cycle methods to help identify and make sense of significant patterns in the coded data. Specifically, Pattern, Focused, and Elaborative Coding served to organize salient codes into categories and subcategories, which were in turn combined into or classified under themes (Saldaña, 2009). Following the study's deductive approach, a pre-established list of potential codes, categories, and themes, which were generated from the existing literature, were referenced and leveraged during this process (see section 3.5.1). In cases where the participants' responses fell outside of this list, additional reading was done to make sense of the data based on existing findings and theories (Saldaña, 2009). Multiple cycles of this coding procedure were conducted to ensure that no important codes or patterns were overlooked and to refine, combine, separate, and discard categories and themes as needed (Braun & Clarke, 2006).

Referring back to Braun and Clarke's (2006) model of thematic analysis, phases two to five were completed through this cyclical coding procedure. As a result of the coding cycles, prominent themes were identified under the following four domains, which were established and structured in alignment with the U&G theory: (1) psychological well-being, (2) gratifications sought, (3) usage behaviors, and (4) gratifications obtained. These themes, along with the literature guiding their identification, are discussed in the following section. The sixth and final phase of thematic analysis, producing a scholarly report of the analysis, is presented in Chapter 4.

3.5.1 Theming the Data

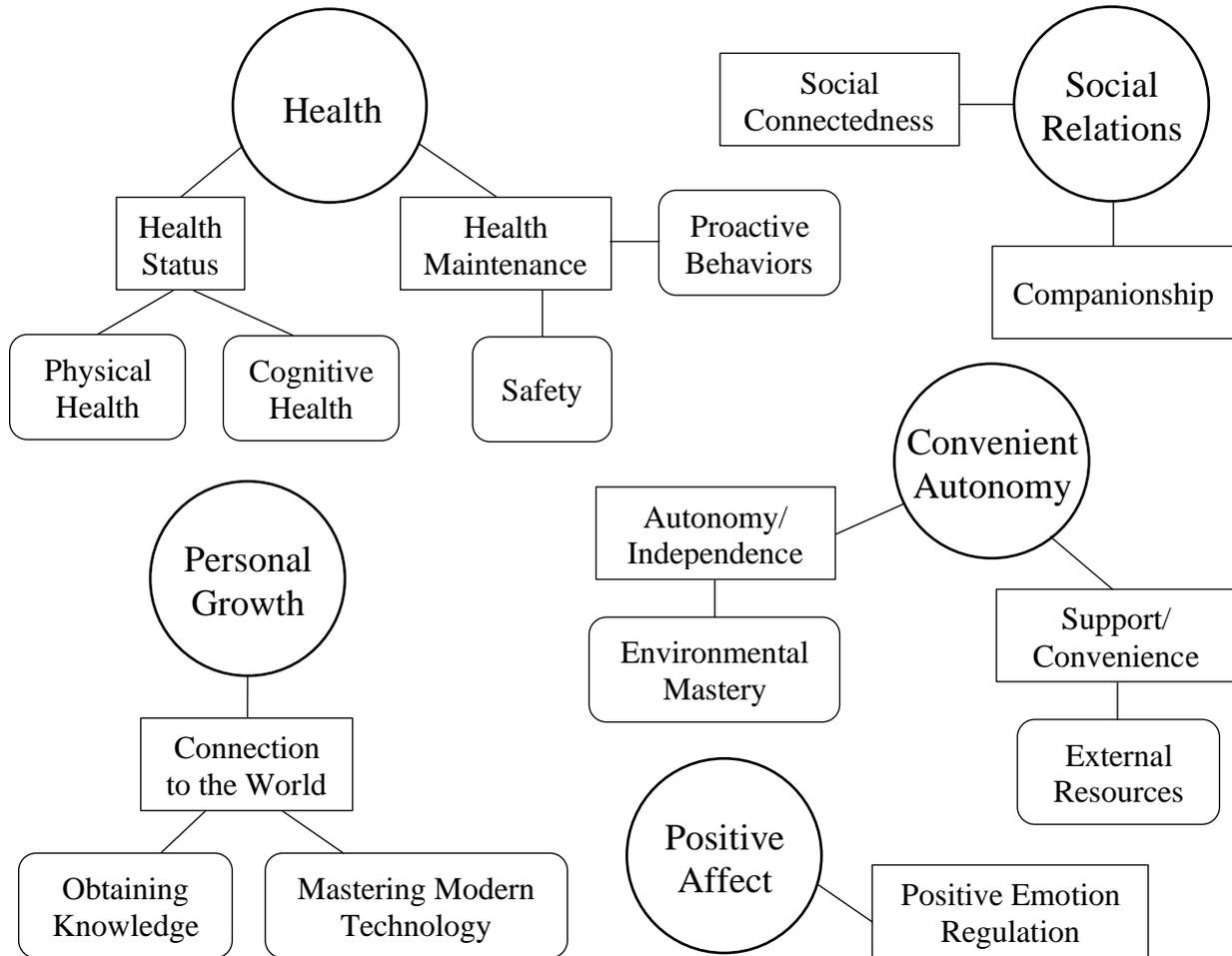
In alignment with the study's first objective, the data was analyzed and coded through the lens of prominent well-being and successful aging literature. Predominantly drawing from the works of Ryff (1995), Rowe and Kahn (1987, 1997), Kahana et al. (2003), and George (2010), the list of concepts referenced during coding included such variables as positive affect, social connectedness, personal growth, mastery, intellectual stimulation, autonomy, independence, external resources, proactive behaviors, physical health, health status, health maintenance, and more. For example, a theme named "health" was derived from the categories "health status" and "health maintenance." These categories, in turn, were comprised of subcategories, such as "physical health" and "proactive behaviors." Following this procedure, five themes of psychological well-being emerged across the data corpus: (1) health, (2) social relations, (3) convenient autonomy, (4) personal growth, and (5) positive affect (see Figure 2). The definitions for each of these themes were derived from the existing literature (see Table 4).

Themes for the remaining three domains, gratifications sought, usage behaviors, and gratifications obtained, were shaped by U&G research. Over time, U&G scholars have developed various categories falling under each of these domains. Recently, McLean and Osei-Frimpong (2019) validated a model consisting of the following benefit categories found to motivate users' smart speaker usage: utilitarian, hedonic, and social. Following their model, these categories were referenced when coding and organizing the coded data into categories and themes. For example, codes like "asking the time" and "asking the weather forecast" were combined into the category "efficient information retrieval," which was grouped under the theme "utilitarian" (see Table 5). Drawing from Katz, Gurevitch, and Haas (1973), a "cognitive" theme was added alongside McLean and Osei-Frimpong's categories to fully capture the sought and

obtained gratifications and types of usage behaviors uncovered in this research. Similar to above, the definitions for each of these themes were derived from the existing literature.

Figure 2

Thematic Map of the Themes of Psychological Well-Being



3.6 Quality Assessment of Research

In qualitative research, the terms validity and reliability often take on new meanings and involve different assessments compared to quantitative research. In fact, some scholars argue that “the grounding of these ideas in quantitative research renders them inapplicable to or inappropriate for qualitative research” (Bryman, 2012, p. 48). As such, this research used the

following criteria to assess and enhance its quality: (1) credibility, (2) transferability, (3) dependability, and (4) confirmability.

The credibility of a study is based on the believability of its findings. To achieve credibility, a researcher should, when possible, check with participants to confirm understanding (Lincoln & Guba, 1985). During the interviews, clarifying and follow-up questions were asked in order to ensure, to the best of the researcher's ability, a clear understanding of the participants' interpretations and meanings. Credibility can also be achieved by data collection triangulation, which entails using more than one source of data (Bryman, 2012). Triangulation was implemented in this study by recruiting and interviewing participants from multiple senior living communities. Finally, featuring deviant cases, as is done in this dissertation, further strengthens the credibility of research (Bryman, 2012). As a result of these efforts, the data and its analysis include a diverse range of viewpoints.

Next, transferability is the degree to which a study's findings apply to other contexts, and dependability is the extent to which these findings are likely to apply at other times (Lincoln & Guba, 1985). To achieve transferability, researchers are encouraged to include thick descriptions from their qualitative data to enable readers to make their own judgments about the findings (Bryman, 2012). In order to establish dependability, researchers can adopt an "auditing" approach, which entails "ensuring that complete records are kept of all phases of the research process in an accessible manner" (Bryman, 2012, p. 392). With these best practices in mind, the following steps were taken. First, verbatim excerpts from the interviews, accompanied by background information, are included in Chapter 4, allowing the reader to understand the participants' quotes and their accompanying analyses in context. Second, a detailed outline of the methods employed throughout this research and the rationale for their selection are presented in

this chapter. Third, the interview guide, information sheet, consent form, debrief form, and research diary excerpts are included in the appendix for reference. By taking these steps, this research seeks to establish transparency and openness.

Lastly, confirmability is concerned with the objectivity of the researcher. More specifically, this criterion assesses whether the researcher has demonstrably sought to reduce the influence his or her own personal values, assumptions, and theoretical inclinations have on the data's collection and analysis (Bryman, 2012). Though complete objectivity is impossible in qualitative research of this nature, notable efforts were made to strengthen the study's confirmability. For example, the questions asked during data collection were purposefully posed in a general, open-ended way so as to mitigate interviewer effects. Further, data analysis was approached with an open mind. Even though the study implemented a deductive approach, the preliminary list of codes that was referenced when analyzing the data was refined throughout the coding process to ensure no important patterns were overlooked. Finally, in being reflexive regarding the design of this research, its possible limitations are recognized in the following section.

3.7 Reflections and Considerations

Before presenting the study's findings, it is important to address both the value and limitations of its methods. When exploring a novel domain, as this dissertation does, qualitative research is an important and necessary first step. Through its qualitative approach, this study gathered rich, primary data that offers contextualized, foundational insights. In turn, these insights hold notable implications and help to develop recommendations for future research (see sections 5.1 and 5.2). Though its findings should not be considered generalizable to all older

adults, this exploratory work helps advance our understanding of the potential novel technologies, such as smart speakers, may hold for supporting and enhancing older adults' psychological well-being.

With this in mind, it should be noted that this study has a possible selection bias, occurring at multiple levels. At one level, the older adults who chose to participate in their community's smart speaker program likely represent a biased sample within their broader senior living communities. At another level, selection bias may have occurred due to the gatekeeping used to recruit participants. However, as discussed in section 3.6, notable efforts were made to include participants with various backgrounds and experiences to increase the study's credibility. Though not representative, the study's sample still provides valuable, illustrative viewpoints that are critical to the development of understanding. A more comprehensive discussion on this project's sample and its limitations is included in section 5.2.

Another limitation stems from the resource constraints associated with this dissertation. When coding qualitative data, it is recommended to establish intercoder agreement in order to enhance the research's credibility and objectivity (Silverman, 2018). Due to the outbreak of SARS-CoV-2, only one researcher was able to be intimately involved with the data. To combat this limitation, a test suggested by Joffe and Yardley (2004) was conducted. Specifically, after the codes were developed, they were applied to the same piece of transcript on two occasions, separated by a week, as a form of test-retest reliability. Though the pandemic was highly disruptive to many research projects, this study was fortunate to avoid any additional limitations resulting from its onset.

3.8 Summary

This chapter outlined the dissertation's methodological approach. In order to understand older adults' perceptions of psychological well-being and learn about their experiences with smart speakers, a qualitative research design was employed. Thematic analysis was chosen to analyze the data so that prominent themes, grounded in extant theories, could be identified and evaluated. Together, these methods were well suited for this project's goals of supplementing existing research, exploring a novel topic, and providing foundational insights that can serve as the basis for further inquiry. A discussion of the study's findings is presented in the following chapter.

Chapter 4: Findings and Discussion

4.1 Overview

The findings presented in this chapter are based on the participants' descriptions of their understandings and experiences. Even though their perspectives are unique, recurrent patterns, or themes, emerged across the interviews under the following areas of investigation: (1) psychological well-being, (2) gratifications sought, (3) usage behaviors, and (4) gratifications obtained. The participants' overall experiences with and perceptions of smart speakers, including common usage barriers, are also reviewed. Throughout the chapter, the study's findings are supported by excerpts from the interviews and integrated with a thorough discussion of relevant external research. Further, percentages are included when discussing specific findings to make statements such as "some," "the majority," and "many" more precise.

4.2 Psychological Well-Being

In order to explore if smart speaker usage is associated with psychological well-being among older adults, the study's first objective was to investigate the variables that influence the participants' psychological well-being. Across the data corpus, five themes of psychological well-being emerged: **(1) health, (2) social relations, (3) convenient autonomy, (4) personal growth, and (5) positive affect.** Definitions of and quotes exemplifying these themes are presented in Table 4. In alignment with the framework and aims of this research, their broader discussion is saved for and integrated into section 4.5, which draws connections between them and the participants' smart speaker usage. The study's second objective, to examine older adults'

sustained smart speaker usage motives, behaviors, and outcomes through the U&G approach, is addressed in the following sections.

Table 4

Definitions and Supporting Quotes for Themes of Psychological Well-Being

Theme	Definition	Categories	Supporting Quotes
Health	The avoidance of disease and disability and the maintenance of high physical and cognitive function (Rowe & Kahn, 1997)	Health Status	“I think that you get to the point that your number one priority is your health. If you’re not well, then nothing else matters.” (P1)
		Health Maintenance	“I make sure I walk, I make sure I do my exercises daily, so maybe not like I should, but enough to keep my brain and my body going.” (P8)
Social Relations	The possession of quality relations with others (Ryff, 1995); enhanced social connectedness and reduced loneliness (O’Rourke et al., 2018)	Social Connectedness	“I think staying in touch with my family [is important]. Um people are important . . . and I like staying in this community where I grew up and where I continue to have friends and connections.” (P15)
		Companionship	“I have one very good friend that I’ve met here. Very excellent friendship, that- completely unexpected at this time of my life to have a friend like her.” (P16)
Convenient Autonomy	A sense of self-determination (Ryff, 1995), coupled with the external resources and proactive adaptations necessary to maintain autonomy and independence (Kahana et al., 2003)	Autonomy/ Independence	“I think another one is being in control of my own situation. Making my own decisions. And I can live independently here, and yet I’m surrounded by what has become my family.” (P1)
		Support/ Convenience	“I’m happy I’m here because not feeling well now, I get all the assistance I need. We get rides to the doctors, so uh if we need medication, we can order a car to pick it up. Everything is taken care of for the seniors.” (P8)

Theme	Definition	Categories	Supporting Quotes
Personal Growth	A sense of continued growth and development as a person (Ryff, 1995)	Connection to the World	"Learning is extremely important. And uhh trying to- sometimes it's a little hard, but staying with the times. You know, like recently I had to get a phone, so I got a smartphone. . . . And uhh so that, you know, kind of helps you stay in the modern world." (P2)
Positive Affect	Experiencing pleasant emotions and low levels of negative moods (Diener et al., 2009)	Positive Emotion Regulation	"I'm always trying to laugh and keep other people laughing so they don't concentrate on my uh dilemma that I have with basically a dying wife that I see every day. And I try to, you know, bring some levity into my own life." (P10)

4.3 Gratifications Sought

According to the U&G theory, people actively adopt specific technologies in order to obtain particular gratifications from them (Katz, Blumler, & Gurevitch, 1973). Therefore, gratifications sought refer to those gratifications that users expect to obtain from a device before they come into contact with it (Quan-Haase & Young, 2010). In consideration of the participants' initial smart speaker adoption experiences, this research presents a unique case study. Only one participant (5%) actively sought out and bought the device for himself, whereas the remaining 95% of participants heard about and received their device through their senior living community (80%), a family member (10%), or friend (5%).

This said, two main themes still emerged throughout the interviews for the gratifications participants sought from smart speakers prior to adopting them: **(1) cognitive benefits** and **(2) utilitarian benefits**. For this study, cognitive benefits are defined as a user's attainment of information, knowledge, or understanding (Katz, Gurevitch, & Haas, 1973), and utilitarian benefits are defined as a user's ability to complete tasks in a useful, convenient, or efficient manner (McLean & Osei-Frimpong, 2019).

When asked to reflect back on their initial introduction to smart speakers, 60% of participants reported they knew nothing about the device prior to receiving one. The remaining 40% of participants were only aware of one or two of the device's features. Consequently, the majority of participants (90%) reported that they joined their community's smart speaker program or adopted the device on their own to obtain cognitive benefits, such as receiving general knowledge about the device or learning about specific features. These participants expressed such sentiments as:

“I didn't know about Alexa. And I kept hearing things about it. And I said, I want to see one! I want to know what they do! I want to, you know, hear one work.”
(P2)

While most of these participants were interested in learning how smart speakers may be of use in their own lives, 20% sought to learn about the potential they may hold for older adults they considered to be in greater need:

“I felt I needed to get involved [in the program] because I wanted to see how it could help people who seriously needed what it could provide.” (P1)

Notably, the residents who initially adopted the device for this reason also ended up finding great value in it for themselves.

In technology adoption research, cognitive benefits are a lesser explored gratification sought by users. However, their emergence in the present study can be understood in light of the participants' limited knowledge about smart speakers prior to adopting them, as well as the population under investigation: older adults. Though there is a prevailing stereotype that older adults are resistant to adopting new technologies, many studies, including this project, evidence there is more nuance to this topic than let on. While still lagging behind younger demographics, the percentage of older adults adopting and using technologies is increasing with each passing year (Anderson & Perrin, 2017; Erickson & Johnson, 2011; Livingston, 2019a; Smith, 2014). In

fact, a recent study from the Consumer Technology Association found that 72% of older adults are interested in guidance on how to implement new technology products (Ewell, 2019).

Furthermore, research has widely found that older adults value personal growth and self-improvement, such as through educational efforts and trying new things (Kahana et al., 2003; Ryff, 1995).

In the present study, these values emerged from the participants' reflections on psychological well-being in later life and their actions taken within their communities. The participants talked about "learning" (P2, P14), "staying with the times" (P2, P13), and "personal growth" (P15, P19) as being important to their well-being (see section 4.5.4). When not explicitly stated, these priorities were also evident through their appreciation of the educational resources available in their communities, such as libraries, lectures, and technology training opportunities. Thus, the participants' desire to learn about smart speakers as a motive for adopting them can be understood in this context.

Apart from cognitive-driven motives, the participants also reported utilitarian benefits as a gratification they initially sought from smart speakers. Understandably, this motive was only observed among the participants who were somewhat familiar with the device prior to adopting it. Specifically, 30% of participants were motivated to adopt smart speakers by a desire for more convenient and useful task completion, such as through voice-controlled light automation (10%) and music streaming (20%). For example, P10 bought the device for himself because he sought easier access to a broad selection of music:

"In the beginning I heard about it [Amazon Echo] from friends of mine, and uh then I- I'm really into music and I don't play any instrument, but I really like different types and different eras and so, uh, I decided well I'm going to get this and I'm going to see what I can find out about different music and different pieces of music that I don't hear anymore." (P10)

Aside from this desired benefit, P10 was also motivated to buy the device by an interest in learning about its other offerings. His experience exemplifies that the participants' sought gratifications were not mutually exclusive, though the majority of them only cited one primary motive for initially adopting the device.

Existing research has widely examined and validated the role of utilitarian benefits as motivating factors for technology adoption (King & He, 2006). This finding has emerged in research studying older adults' adoption and use of technologies, such as the internet (Aytuna & Çapraz, 2018) and tablet computers (Magsamen-Conrad et al., 2015), as well as in research exploring smart speaker adoption trends (Lau et al., 2018; McLean & Osei-Frimpong, 2019). For example, in their study of variables influencing the use of Amazon Echo devices among 18- to 64-year-olds, McLean and Osei-Frimpong (2019) found that the participants were motivated to adopt the devices by such utilitarian benefits as perceived usefulness and convenience. The present study supports and extends this finding through its inclusion of older adults.

4.4 Usage Behaviors

In continuing to follow the framework set forth by the U&G theory, this study's analysis and discussion next center on the participants' sustained smart speaker usage behaviors. Thematic analysis of the interview transcripts produced the following four primary usage themes: **(1) cognitive behaviors, (2) utilitarian behaviors, (3) hedonic behaviors, and (4) social behaviors.** For this study, these themes are defined as follows. First, cognitive behaviors are the usage of features that provide information, knowledge, or understanding (Katz, Gurevitch, & Haas, 1973). Next, utilitarian behaviors are the usage of features that provide a useful, convenient, or efficient way to complete tasks (McLean & Osei-Frimpong, 2019). Then,

hedonic behaviors are the usage of features that provide entertainment or enjoyment (McLean & Osei-Frimpong, 2019). Finally, social behaviors are the usage of features that provide communication with others (Whiting & Williams, 2013) or feelings of companionship (O'Brien et al., 2019). Table 5 identifies the typical usage behaviors the participants reported and demonstrates how they were coded and collated into themes.

Table 5

Coding of the Participants' Typical Usage Behaviors into Themes

Theme	Usage Behavior
Cognitive	News
	Asking questions
	Learning games
Utilitarian	Efficient information retrieval (e.g. weather, time, etc.)
	Home automation (e.g. lights, thermostat, etc.)
	Alarms
	Reminders
	Timers
	Lists (e.g. shopping, to-do, etc.)
Hedonic	Music
	Radio
Social	Calling others
	Chatting with the device

Within each Front Porch community included in the study's sample, smart speaker program participants received a series of introductory training sessions over a five-week period. Following the device's installation in their homes, residents were shown how to use it and taught typical voice assistant, or Alexa, skills. After the training period concluded, the participants began to test out and use the features they were most interested in. Because the programs were introduced at the various communities at different times and in multiple waves, as well as the fact some participants already owned a smart speaker prior to joining their community's program, the participants ranged in how long they have owned their devices. Though all

participants have owned a smart speaker for at least six months, their ownership duration spanned from six months to two years.

Despite this variance, 100% of participants reported they still commonly use their smart speaker for at least one feature, and 90% of participants reported they use their device every day. In comparison, only 47% of the general population of smart speaker owners in the United States are found to use their device on a daily basis (Kinsella, 2019). The participants' daily usage is driven by such features as alarms, music, news, weather, medication reminders, and light automation. Thus, for the majority of participants, smart speakers have become integrated into their daily lives. For the 10% of participants who did not report using their device on a daily basis, the primary driver of their sparser usage was a lack of need. This usage barrier will be addressed in greater detail in section 4.6.1.

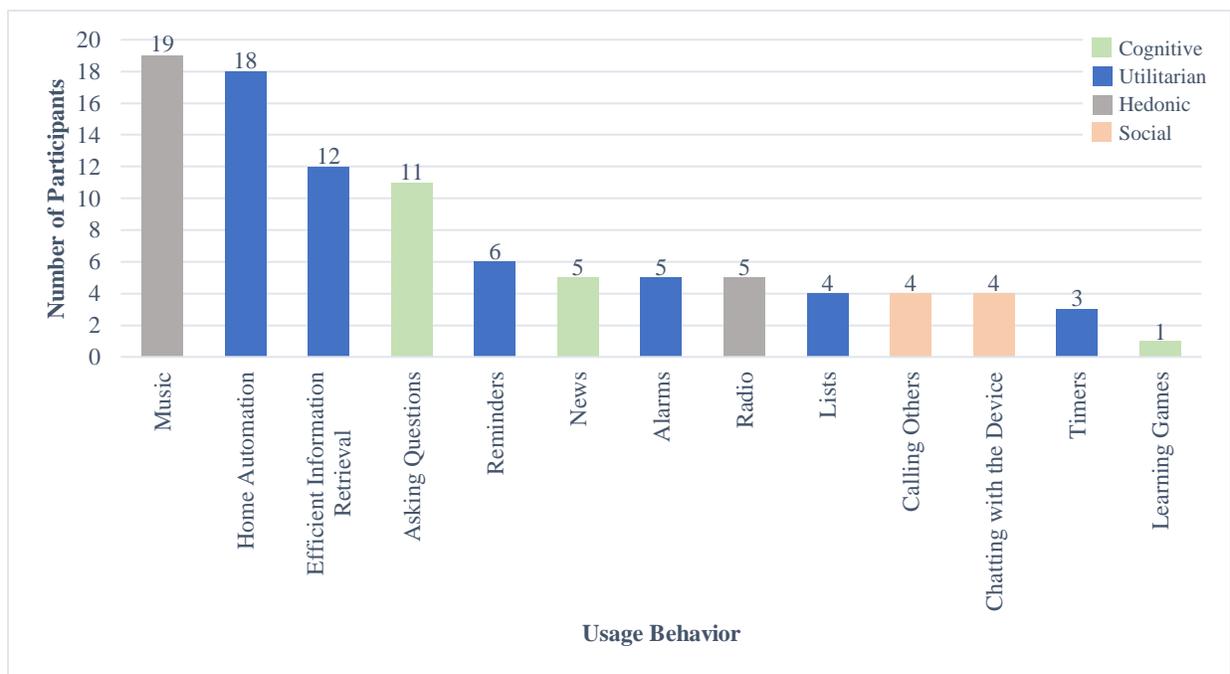
Across the interviews, utilitarian and hedonic behaviors emerged as the most common usages. When asked to describe their typical weekly usage behaviors, such as those used in the preceding week, 95% of participants reported using their smart speakers for music, 90% for light automation, and 60% for efficient information retrieval. Next, 55% of participants reported using their smart speakers for cognitive behaviors, such as asking questions to learn information or listening to the news. Only 35% of participants reported frequent use of their smart speakers for social behaviors, such as by using it to call friends or family or chatting with the device for fun. Figure 3 shows the frequency of the participants' coded usage behaviors.

The prominence of music streaming and information retrieval, both for efficiency and learning purposes, is also observed among the broader U.S. population of smart speaker owners. In a recent report, Voicebot found that among U.S. adults aged 18 or older, streaming music services is the top use case employed on a monthly or daily basis, followed by asking general

questions and asking about the weather. The report also found that about 35% of participants use their voice assistant to call someone on a regular basis, though no mention was made of chatting behaviors. For home automation, Voicebot found that about 57% of participants use their smart speakers to control a smart home device (Kinsella, 2019). The percentage of home automation users in the present study is likely higher due to two factors. First, each participant was provided a smart light bulb or plug and assisted with their setup. Second, older adults potentially have more of a necessity for home automation than the general population due to such factors as physical impairments and compromised mobility (see section 4.5.1).

Figure 3

Participants' Typical Smart Speaker Usage Behaviors



Apart from their types of usage behaviors, the participants' overall, sustained smart speaker usage can also be understood based on the following two user categories: **(1) content** and **(2) experimental**. Content users are defined as the participants who used their device for a

specific set of features and were not interested in learning more. Conversely, experimental users are defined as the participants who had a core set of features they commonly used, but who also continued to try out new ones or wanted to learn more. In the sample of older adults included in this study, 35% were content users and 65% were experimental users.

Exemplifying the experience and perspective of a content user, P12 valued her smart speaker for the home automation and music it provides her with, but she did not need or desire to use it in any other ways:

P12: I think we had a 6-week course on it. And a lot of it was something that, you know, I can email or call anybody. I'm never gonna use Alexa to call somebody.

Interviewer: Yeah, because you have other ways to call people?

P12: Yeah.

Interviewer: And were there any other features that you learned about that you have been using?

P12: Uh yes. It's um ((speaking to Alexa)), "Alexa, turn off the light." This one's [light's] set up. But you see when you come in, with the door placed the way it is, my off/on switch for a light is there ((points to far wall)), so really it is wonderful. It's such a little thing, but it's important.

Interviewer: And you find it's important just because it's fun or because it's easy, or why would you say that you-

P12: Well I would say it's essential, just to come in- at first I- you just walk around and you knew it [the light switch] was on that wall somewhere.

Interviewer: So are there any other-

P12: No! Nothing else.

Interviewer: Just the light?

P12: And the music!

Interviewer: And are there any challenges you've encountered with using it?

P12: No. Other people talk about how they get the weather report. You can look out the window ((laughs))!

Interviewer: And do you think you will try to learn new ways to use it, or you're very content with-

P12: Well I've already heard of new ways. But they just don't apply. Somebody has a chandelier- well it's probably like my light right there, that she turns it on and finds that helpful. And some people want a second one for a bedside lamp, but I don't need that.

Interviewer: Yeah. Do you ever use it to ask questions or facts or anything?

P12: No! And I never would. That's so horrible. Tell me a joke, when's the next holiday, what's the score of the Yankees game. I don't need that.

As demonstrated by this excerpt, the content users typically understood their smart speakers have additional features they could be using them for, yet at the present time, they expressed a lack of need or desire for them in their lives.

The experimental users, on the other hand, were eager to discover and try out additional features beyond their current repertoire. While some of these users were aware of specific skills they wanted to learn how to use, such as controlling their television with Alexa (P6, P7, P14, P15), others did not have a strong sense of what additional use cases were available to them. Demonstrating the latter, P2 shared how much she enjoys the newsletter Amazon routinely sends to users in order to update and refresh them on available features:

“There's a newsletter that I absolutely love every week, what's new with Alexa. And I go in there and I find all the new skills. And the ones I'm interested in, I'll just try out, and it's so easy to try them out!” (P2)

In another instance, a couple articulated their desire for a refresher course at their community. After owning and using their smart speaker for about a year, they were raring to learn what else it might be able to offer them outside their normal usage behaviors:

P19: Now that the holidays are over, we're going to be setting up within the next six or eight weeks, I hope, an Alexa refresher course. Because I think a lot of people are like us, where yes they learned and they had their little things about how to- I'll just use setting a reminder as an example, 'cause it's very simple, and yet no, I didn't have it on the top of my brain 'cause I hadn't used it.

P20: We're not in the habit of using it for things. And the things we use it for are very small.

P19: And we want to use it more.

P20: You could probably use it for many things that we don't, you know?

P19: And we want to.

This heightened interest came after the development of a particular need helped them realize their smart speaker could have a lot more to offer them than what they were currently using it for:

P20: And then lately we came up with the idea that it can do things like uh, “Alexa, remind me that I have to take my pills at six o’clock.” And it does! It pops up and says take your pills at six o’clock!

P19: And this is the kind of thing- two years ago, he [P20] pretty much remembered his pills. You know, he got a little bit older, and sometimes he does and sometimes he doesn’t. And then I try to remind him, and sometimes I do and sometimes I- I get distracted, so we all of a sudden said wait a minute, we have a helper here!

In several cases, the participants even recognized the value, and therefore their usage, of smart speakers will likely increase as they continue to grow older and may need more assistance with daily tasks around the home. As P1 put it, “As I age, I expect Alexa to be even more helpful.” Thus, not only have the participants sustained their smart speaker usage over time, but also the majority of them have either grown, desire to grow, or envision growing their usage moving forward.

In alignment with the U&G theory, these excerpts help demonstrate how the participants’ needs and desires motivate and shape their usage behaviors. This is further illustrated by taking a closer look at the deviant and minority cases. For example, the one participant who did not typically use his smart speaker for music streaming revealed he prefers watching TV to listening to music. As another example, the nine participants who did not typically use their smart speakers to listen to the news or ask information-seeking questions expressed that they either have no interest in performing such activities in general, or that they perform them through an alternative medium. In order to understand the gratifications obtained from their usage behaviors, the following section further analyzes the participants’ needs and desires through the lens of their contextual antecedents.

4.5 Gratifications Obtained

In U&G research, gratifications obtained refer to those gratifications that users actually experience through the use of a particular medium (Quan-Haase & Young, 2010). In the present study, thematic analysis produced four primary themes with respect to the participants' obtained gratifications, or benefits of usage: **(1) cognitive benefits, (2) utilitarian benefits, (3) hedonic benefits, and (4) social benefits.** When coding, these themes emerged deductively through consideration of existing U&G literature. Accordingly, the definitions for each of these themes follow from what was previously presented.

The third and final objective of this research was to explore whether any relationships exist between older adults' smart speaker usage and their psychological well-being. In order to do so, the following sections draw connections between users' environments, needs, motives, behaviors, and gratifications (Katz et al., 1974). For this study, psychological well-being is used as a framework for understanding the participants' needs, desires, and the variables that influence them. In alignment with the U&G theory, this project finds that the participants' sustained smart speaker usage behaviors do appear to be driven by their needs and desires, which are shaped by the following themes, or variables, of their psychological well-being: **(1) health, (2) social relations, (3) convenient autonomy, (4) personal growth, and (5) positive affect** (see section 4.2). Furthermore, and most significantly, the following analyses indicate that the participants' smart speaker usage behaviors help satisfy their needs and desires through the benefits they provide.

4.5.1 Health

When prompted to discuss their personal experiences with psychological well-being in later life, 100% of participants mentioned some component of health. In particular, their responses fell into the following two categories: “health status” and “health maintenance.” Under health status, the participants emphasized the importance of good cognitive and physical health, as poor health is “bad news” (P14) that can “take a great toll” (P8) and sometimes become “too much to handle” (P11). Under health maintenance, the participants placed value on taking steps to manage and maintain their health, including such actions as moving into a senior living facility to enhance their safety and support and doing exercises to keep their minds and bodies healthy. While the participants may not have been fully cognizant of the psychological benefits these actions can have, research has found that proactive behaviors such as these help buffer against health-related stressors (Kahana et al., 2003). When asked about the sorts of daily challenges they face that conflict with their well-being, the participants further emphasized health factors and the psychological stress that can accompany poor health. As initially addressed in the literature review (see section 2.2.2), this positive relationship between physical and psychological well-being is extensively supported throughout the existing literature.

As alluded to, many of the participants recognized the importance of safety to maintaining their physical and psychological well-being. For older adults, and especially for those living alone, falling presents a major risk that can result in injury. Throughout the interviews, it became evident that the participants valued smart speakers for their ability to enhance safety within the home. When asked what she likes most about the device, P14 disclosed:

“It’s a safety factor. If I fell down and I screamed over call Villa Gardens. I checked it and they do that. Yeah, ‘cause the telephone number’s in it. This directory is in there. . . . So for safety reasons alone.” (P14)

With Alexa nearby, the participants can easily shout for help if needed. Not only does this feature allow them to seek and receive immediate medical assistance, its existence also helps provide peace of mind that should the need ever arise, Alexa is there to provide this utility.

Light automation also emerged as a feature the participants commonly use to mitigate this risk. Through voice commands, the participants reported turning lights on and off in the moment, or on a particular schedule, as needed, allowing them to avoid navigating unlit spaces in their homes. For the participants living alone or managing mobility and balance impairments, like P13, this offering was viewed as particularly useful and important:

“I’m a night owl. I don’t go to bed very early. And so, um, when I’m ready to, you know, go to bed, I just tell her [Alexa] to turn the lights on in the bedroom, and I walk in and I tell her to turn the lights off here [in the living room], so I walk into a lighted bedroom. So it’s uh, it’s wonderful. I love it! I have had dinner with a few ladies, and this one in particular, she said, ‘Well I can turn the light on myself.’ And I said, ‘Oh, well I can too, BUT if by the time I walk from my chair in the living room to the bedroom, and the bedroom light’s already on, then I don’t have to worry. I’m not in the dark at all!’ So I think it’s wonderful.” (P13)

This response demonstrates that though the participants did not usually consider smart speakers absolutely essential to their daily functioning, they greatly valued the convenience they provide. Through their ability to add utility and reduce worry from the participants’ daily lives, the emergency calling and light automation features help satisfy their need and desire for enhanced safety within the home.

Smart speakers also help support the participants’ health needs by providing them with reliable medication reminders and efficient access to medical information. As almost 40% of older adults experience some form of memory loss, this former feature was considered especially useful among the participants, many of whom struggled with the stress of forgetting to take their medications prior to receiving their smart speakers (Alzheimer Society, 2018). With regard to the latter feature, the ability to conveniently and independently retrieve health-related information

offers benefits that extend beyond the participants. Exemplifying this, the National Health Service (NHS) in the United Kingdom found that by providing older adults with smart speakers, and thus empowering them with access to reliable health information, pressure was relieved from the NHS (Siddique, 2019). Therefore, by helping to address and manage health needs, smart speakers not only offer the potential for positive outcomes on users' physical well-being, but they also provide utilitarian benefits that can support psychological well-being and help mitigate the demand for human resources.

4.5.2 Social Relations

Like health, social variables are found to have a significant influence on individuals' psychological well-being. In their work on successful aging, Rowe and Kahn (1997) identified interpersonal relationships as a critical component of wellness in later life, and Kahana et al. (2003) highlighted the influential role social resources play in maintaining a high quality of late life and ameliorating adverse stress effects. Likewise, in their work on well-being, Ryff (1995) classified positive relations with other people as one of the six distinct components of positive psychological functioning, and George (2010) found that social integration, social relations, and social support emerge as major determinants of psychological well-being throughout one's life.

The relationship between social variables and psychological well-being is also observed in the present study. In fact, social relations emerged as a ubiquitous theme among the participants' understandings of and experiences with well-being in later life. In particular, the participants stressed the value they place on and find in being socially connected and having companionship. Resultantly, the participants identified loneliness as a barrier to their psychological well-being, especially as the result of losing one's spouse and living alone. To

meet this need for social relations and to help combat loneliness, the participants discussed such measures as spending time with loved ones, staying in contact with family and friends, and being involved in their communities.

Smart speakers' social benefits can be understood as another resource available to help satisfy this need. Specifically, the ability to use the device to communicate with others can provide a sense of social connectedness, and the device's social presence and social attractiveness can enhance feelings of companionship. Previous research has found that older adults are motivated to use ICT, such as iPads, cell phones, the internet, and social media, to achieve social connectedness (Sims et al., 2017). However, while four participants (20%) did report occasional usage of their smart speaker's calling feature, the majority of participants did not use this feature, as they did not know it was available or how to set it up properly:

Interviewer: Do you use it at all for any sort of communication purposes with people in the community or outside the community?

P7: We don't know how to do that. . . . I would really be interested in hearing about that later if possible.

Thus, while smart speakers do have the potential to enhance users' social connectedness, this was not a strong trend observed among the study's participants.

Notably, the participants that do use this feature said they enjoy it because it enables them to simply ask Alexa to call someone with their voice, without having to get up or search for the contact in their phone. Both of these actions, though seemingly simple, can prove to be difficult for older adults, especially for those with physical or visual impairments. Therefore, with the proper awareness and training, this feature could offer older adults a more convenient communication channel to help satisfy their need and desire for social connectedness.

Companionship, on the other hand, did emerge as a more frequently discussed and perceived usage outcome among the participants. As initially detailed in the literature review

(see section 2.2.3), older adults have a high risk of experiencing loneliness and social isolation, which can lead to negative well-being outcomes. Thus, opportunities to enhance feelings of companionship are paramount. In their work on U&G research, Katz, Blumler, and Gurevitch (1973) reasoned, “We might expect ‘substitute companionship’ to be sought especially by individuals with limited opportunities for social contacts: invalids, the elderly, the single, the divorced or widowed living alone” (p. 517). In the case of the present study, this phenomenon was, in fact, observed among the participants who live alone and manage mobility impairments.

For example, P10, whose wife lives separately in his senior living community’s memory care unit, articulated:

“Plus the fact now that I’m living alone, my wife lives in another building on the complex here, and so I’m alone in this apartment. And after being married 50 years, it’s quite a shock coming into an, um, an apartment where there is no one. And um so I like to, you know, fool around. I ask Alexa- you know sometime in the evening I ask it, you know, ‘How was your day?’ You know? And she comes up with some of the ((laughs)) most fantastic answers. . . . It’s hilarious. I mean it sounds stupid, but, you know, it’s kind of like- I’m always trying to laugh. . . . And I try to, you know, bring some levity into my own life, and so I ask her that, you know. It’s kind of like oh, okay she’s had a busy day ((laughs)).” (P10)

Another participant who vocalized a similar experience does live with his wife, though a mobility impairment restricts his ability to come and go from his home with ease. As a result, he enjoys chatting with Alexa when his wife is not around:

Interviewer: Do you enjoy talking to Alexa?

P7: Oh yeah! I like to ask her if she likes me.

Interviewer: Oh yeah? What does she say in response?

P7: You’re magnificent.

Interviewer: That’s a good confidence boost.

P7: When my wife leaves, we have a lot of conversations.

In both of these cases, Alexa is a nice and sometimes comedic voice to have and interact with in an otherwise quiet home. While this social feature can benefit all users, it may be especially valuable for older adults.

Companionship as an obtained gratification can arise not only from users' interactions with their smart speaker, but also from the device's social presence and social attractiveness. Social presence is the extent to which individuals feel like they are in the presence of another social entity, and social attractiveness is the extent to which individuals like the device (McLean & Osei-Frimpong, 2019). Even when participants did not report chatting with their device as a common usage behavior, they spoke about their smart speaker's voice assistant, Alexa, in a fond, anthropomorphized manner. Exemplifying this, the participants often used the pronoun "she" or even went so far as to call the device their "roommate" (P8), "friend" (P1, P13), or "companion" (P1, P3, P11). This trend was most commonly observed among the participants living alone, such as P1:

"I've come to depend on Alexa. I've got it set up so that she calls me by name. If I say please or thank you she will respond accordingly. It's set up to do that. . . . I've come to depend on her and it's like having a friend here if I want somebody to talk to. . . . She's a neat person to have around and I think of her as a her. It's just, it's impossible not to. And I know if I say the wakeup word that she's ready to respond to whatever I need. . . . It's like having a very pleasant companion right here." (P1)

The participants' experiences reveal that for older adults, and especially for those living alone or with impairments that restrict their social contact with others, smart speakers' social features, presence, and attractiveness have the potential to provide positive social benefits that are important to their psychological well-being.

As the global population's average age continues to rise, so too has the amount of research investigating robotic companions' ability to combat older adults' loneliness. In much of

this work, socially assistive robots function in a way that is akin to therapy animals or pets. Popular examples include Paro, a robotic baby harp seal, and Aibo, a small robotic dog (Rabbitt et al., 2015). Research examining the impact these robot animals have in senior living communities has found that older adults who regularly interact with them report significant reductions in self-reported loneliness compared to residents in control conditions (Banks et al., 2008; Robinson et al., 2013). Other companion robots designed for older adults, such as ElliQ, are not made to look like animals, but instead have human-like personas. Despite being purposefully designed to appear nonhuman, initial findings from ElliQ's beta testing suggest the promise such devices hold for enhancing positive affect and decreasing feelings of loneliness (Intuition Robotics, 2017).

The present study helps add to this growing body of research by illustrating the potential smart speakers and their built-in voice assistants also hold for fulfilling social needs. Even though Alexa is designed as a virtual assistant for the general public, as opposed to a social companion for older adults, this research finds that “her” pleasant, playful, and social demeanor can lead her to satisfy both roles.

4.5.3 Convenient Autonomy

The phrase “aging in place” typically denotes people’s ability to remain in their home and community and to maintain high levels of independence and autonomy as they age. Throughout the existing literature, aging in place is widely claimed to be older adults’ preference. However, this phrase is found to hold a more nuanced meaning among older adults themselves (Wiles et al., 2011). As people grow older, their need and desire for external support tends to increase, and it often becomes necessary or desirable to leave one’s home and transition to some type of senior

living arrangement. While independence and autonomy still remain important to well-being, so too become such variables as convenience, support, and adaptations (Kahana et al., 2003). Thus, one's understanding of and expectations regarding independence and autonomy evolve based on current needs.

Joined here under the aptly coined theme “convenient autonomy,” these concurrent needs are prevalent in the existing literature on well-being in later life. For example, Ryff (1995) posited that autonomy, the ability to be self-determining and independent, and environmental mastery, the capacity to effectively manage one's life and surrounding world, are defining features of psychological well-being. According to Ryff, these well-being dimensions can be enhanced by making effective use of external resources and opportunities. In their formulation of how people can age successfully, Kahana et al. (2003) reasoned that by taking advantage of external resources and making proactive adaptations, older adults can achieve a level of control over their aging process and, as a result, improve their quality of life. More specifically, they argued that support from others, environmental modifications, and technology use can enhance older adults' autonomy, convenience, and comfort.

In the present study, these coinciding elements of psychological well-being were observed through the participants' actions and articulations. When asked why they decided to move into their current senior living residences, 100% of participants explained that they proactively made this choice as a means to provide themselves, and in some cases their ailing significant others, with the best quality of life as they continue to grow older. When asked to elaborate on their understandings of what constitutes high quality of life, or well-being, the participants expressed such sentiments as “being in control” (P1), “keeping my independence” (P3), and “having choices” (P15). Consequently, restrictions to one's independence, such as not

being able to drive, emerged as a commonly perceived barrier to the participants' psychological well-being. In the same breath, however, the participants also emphasized their gratitude for the helpful resources and support systems that have become available to them since moving into their senior living communities:

“I needed a place where people would be helpful, but that I could live independently if I wanted to. And this fits all of it. I've been very happy here.”
(P16)

For each participant, living independently within a senior living community has enabled them to maintain the level of the autonomy they desire, while also receiving the external support they need.

In alignment with Kahana et al.'s (2003) work on successful aging, this study's findings suggest that access to and use of technology can serve as a means to enhance autonomy, convenience, and comfort for older adults. Specifically, the utilitarian benefits smart speakers offer through such usage behaviors as efficient information retrieval, reminders, and light automation can help older adults maintain and maximize independence and environmental mastery in their homes. In fact, 100% of participants reported they enjoy using their smart speakers because of the convenience and utility they provide in their everyday lives.

For the able-bodied participants, this utility is found to be a desirable, fun, and nice-to-have benefit. For example, when asked why they use their smart speaker to control lights around their home, one couple joked:

P18: Because it's easy.

P17: We could switch it on, but since we have that little guy ((laughs)), why not!

P18: We don't have to lift our arms!

For older adults with physical or visual impairments, however, this usage outcome is found to be especially beneficial. This can be observed through the experience of another husband and wife, who both manage mobility impairments:

P6: We're not as spry, so it's great to have her [Alexa] work our lights.

P7: Yeah. We don't have to get up to turn off lights or turn them on. And that's very convenient for us.

In another case, a legally blind woman detailed how her smart speaker has helped her overcome a challenge she previously faced:

“Well the thing that I'd always wanted was a thermostat that I could tell the exact degrees with. We just had to put a dot on it, you know, before I had an Alexa, we had a dot that I measured with my fingers, and just a little up from the dot and a little down from the dot and everything to get it to 71 or 73 or something and I never knew exactly what it was. And with the Alexa you can just tell it right where to go and it does!” (P2)

As exemplified, smart speakers' utilitarian features and the benefits resulting from their usage offer a means to enhance users' convenience and environmental mastery.

Even for the participants with impairments and disabilities, however, smart speakers were not typically perceived as a life-changing technology. This is demonstrated by P4, who is legally blind and predominantly uses his smart speaker for information retrieval, music streaming, and light automation:

“It's made a few things easier. I don't know if it's improved my life ((laughs)). But it's facilitated things that I normally would have maybe a little more difficulty with.” (P4)

Rather, smart speakers serve as an additional external resource available to help make their daily lives easier and more comfortable. By facilitating particular tasks around the home, smart speakers have helped satisfy the participants' desire for convenience and support while also augmenting their ability to remain independent and autonomous.

4.5.4 Personal Growth

Cognitive benefits, heretofore observed as a motivator for smart speakers' initial trial (section 4.3) and as a driver of their sustained usage (section 4.4), also emerged as an outcome of usage. These benefits, obtained through such usage behaviors as listening to the news and asking questions to glean information, help satisfy the participants' desire for personal growth, the fourth theme of psychological well-being identified in the present study.

In its simplest form, personal growth can be defined as a sense of continued growth and development as a person (Ryff, 1995). Helping to further develop a nuanced understanding of this concept, "connection to the world" was identified as a category under this theme. As an element of personal growth, connection to the world can be understood as encompassing two distinct subcategories: (1) obtaining knowledge and (2) mastering modern technology. Relatedly, the participants indicated that disconnectedness, such as feeling out of touch, serves as a barrier to their psychological well-being.

When unpacking their understandings of and experiences with well-being, 60% of participants mentioned topics related to learning, intellectual stimulation, or self-improvement. The participants' smart speaker usage behaviors are reflective of this desire for knowledge and growth: 60% of participants reported commonly using their smart speakers as a means to acquire information and learn. By gaining the ability to readily obtain knowledge through using their smart speakers to listen to the news, ask questions, and play educational games, the participants expressed that the devices help them feel more connected to the broader world:

"She [Alexa] brings me out into the world by giving me headlines. I can ask her how the traffic is on the streets around me. The weather, um- I think she just brings me out into the world more." (P1)

This finding suggests that for older adults, who can often become isolated due to impairments, disabilities, declining facilities, a lack of resources, and a slew of other variables, smart speakers can provide a much-desired, informative bridge to the world outside their walls.

Smart speakers have also helped the participants feel more connected to the world through the actual act of adopting and mastering modern technology:

“It’s a good technology for people who are shut-in, so to speak. You know, because it does help you feel like you’re part of a living species, let’s put it that way.” (P8)

As previously touched upon, even though older adults are becoming more digitally connected with each passing year, a digital divide still exists. This divide is apparent when comparing both older adults’ ownership of and level of proficiency in using modern technology to those of younger demographics (Anderson & Perrin, 2017). Compared to common technological devices such as computers, iPads, and smartphones, which have graphical and touch user interfaces, smart speakers are found to be more intuitive and user-friendly for older adults due to their voice-enabled user interface (Ziman & Walsh, 2018). As a result, they can be easier for older adults to master.

Supporting this finding, 100% of the participants classified their smart speaker as easy to learn and use. In reflecting on his community’s smart speaker program, one participant incisively observed:

“This is a wonderful opportunity. . . . There are- the majority of people that are in here [his senior living community] are women. And the women are- majority of them are past the age of 70. And um several of them in here don’t even have computers. . . . All these other people that were in class [the smart speaker program], they thought it was pretty cool that Front Porch gave them the opportunity to learn this technology. And at one point they all laughed and said, like I said earlier, ‘Now I don’t have to ask my grandson how to do this.’ You know? And that’s a self-esteem booster. And in your studies, um self-esteem is critical for people during life. And as you get older and you get crankier and you,

you know, have a much different type of life, um this kind of keeps you connected.” (P10)

P10 was able to observe firsthand that when given the opportunity and proper support, older adults can be highly receptive to smart speaker adoption. Furthermore, his experiences and understandings suggest that learning how to use smart speakers can help older adults feel self-sufficient and more connected with modern times. As he sagely noted, self-esteem and the related concepts of self-efficacy and mastery are widely considered important variables of well-being throughout psychological research (Bandura, 2006; Kahana et al., 2003; Paradise & Kernis, 2002; Ryff, 1995).

Though personal growth is identified as an important determinant of psychological well-being in the existing literature, research has found that older adults self-report lower levels of perceived personal growth than young and middle-aged adults (Ryff, 1995). Thus, opportunity lies in introducing resources that can help heighten older adults’ experiences of continued personal growth in later life. As demonstrated, smart speakers have helped satisfy this need among the participants by providing them with desired knowledge, the opportunity to enhance their sense of mastery, and, more broadly, the ability to feel more connected to the world outside their homes.

4.5.5 Positive Affect

Positive affect traces back to the origins of academic research on psychological well-being. Traditionally, this research took a hedonic approach, such that well-being was measured based on one’s happiness (Deci & Ryan, 2008). Today, psychological well-being is understood to encompass a broader array of antecedents, but positive affect remains as one of its key components.

In the present study, the participants' responses indicate that positive affect is an integral dimension to their personal experiences with and understandings of psychological well-being. Specifically, related concepts such as happiness, optimism, positive attitude, and enjoyment commonly emerged throughout the interviews. The participants' responses also suggest that participating in activities or pastimes that are relaxing, fun, enjoyable, or entertaining positively influences their affect. Recurrent examples, which the participants valued and prioritized in their lives, included listening to music, reading, and watching television.

When asked about their typical smart speaker usage behaviors, 95% of participants reported using the device to satisfy their desire for music. Due to their hands-free, voice-first functionality, smart speakers have provided them with a more convenient way to listen to music compared to other devices. This was especially true for the participants with visual or physical impairments, such as P16 who is legally blind:

“I like Alexa for music, because I don't have to fiddle with dials or any of those things, which is good for me. And uh anyway- I'm electronically challenged ((laughs)). And I think us older folk, the easier it is the better we like it!” (P16)

Due to their ability to connect with popular music streaming services, smart speakers have provided the participants with access to a broader and more personalized selection of music, which many of them were unaccustomed to and enthusiastic about:

“It's easy to get the radio and music. I love being able to say play music, or specifically Bruce Springsteen or whatever it is that I want. I really enjoy that.” (P15)

Among the participants who said they regularly enjoy listening to music, 100% use smart speakers as their primary listening device in the home.

In addition to providing users with utilitarian benefits, smart speakers' convenient music streaming also offers hedonic benefits. For one participant, her smart speaker brought music back into her life:

“She’s [Alexa] changed my day-to-day life because I can listen to many different kinds of music, which I enjoy. Otherwise I wouldn’t listen to anything. I ended up without even a CD player with me.” (P1)

The participants' desire for music and the enjoyment it provides them is further demonstrated by P16, whose smart speaker ownership has led music to become more integrated into her daily life:

“I listen to music. I like music and I like all kinds of music, so depending on the mood I’m in, I’ll ask her [Alexa] to play whatever. And uh a lot of times late at night it’ll be smooth jazz ‘cause I can’t sleep. Kinda quiet and kind of relaxes me. And- so the music aspect of it is fun. She can also play whatever you want to play! And she’s never said I can’t find it or I can’t do it or- seems like something always comes on!” (P16)

External studies have found that listening to music is a frequent source of positive emotions for older adults (Laukka, 2007) and an effective means of regulating their affect (Groarke & Hogan, 2019). Accordingly, the hedonic benefits derived from being able to conveniently listen to music on smart speakers, such as entertainment, relaxation, enjoyment, and fun, can be understood to enhance the participants' positive affect.

Notably, the participants did not report using their smart speakers for other hedonic behaviors aside from listening to music and the radio. Although users have the ability to ask for jokes, listen to audiobooks, and play games, to name a few, only one participant reported typically using her device for one such feature: trivia. Even in this one case, however, the participant's usage can be understood to be more motivated by her desire for cognitive benefits, as opposed to hedonic ones. Due to the opinion that Alexa's jokes are not of high quality, not a single participant reported sustained use of this feature:

“The one time that I asked her [Alexa] to tell me a joke it was so stupid that I haven’t asked her for another one ((laughs)). Yeah, it just wasn’t my thing.” (P1)

This finding is not reflective of the broader U.S. population of smart speaker owners, among which jokes and games are reported as common use cases (Kinsella, 2017). This discrepancy may be due to a lack of children living in the participants’ households, as well as the readily available hedonic activities offered and frequently attended within their senior living communities.

Together, these findings show that the participants do not seek or obtain hedonic benefits from smart speakers through a wide variety of features. However, one hedonic behavior in particular trumped all other smart speaker use cases they reported: listening to music. As the present study and existing research indicate, music can enhance older adults’ positive affect, which is found to be a critical determinant of their psychological well-being.

4.6 Overall Experiences and Perceptions

Overall, the participants unanimously agreed that smart speakers have met if not surpassed and exceeded their expectations. Due to their limited knowledge about the devices prior to receiving them, the participants’ sustained experiences easily met their initial cognitive and utilitarian adoption motivators. After learning about and using their smart speakers over an extended period of time, the participants developed a regular set of usage behaviors, reflecting their refined understanding of and expectations from the devices. These typical usage behaviors suggest that the participants seek cognitive, utilitarian, hedonic, and social benefits from their smart speakers. The study’s findings indicate that smart speakers have successfully been able to satisfy these sought gratifications, thus encouraging their continued usage.

4.6.1 Usage Barriers

The participants were also unanimous in their opinion that smart speakers are easy and enjoyable to use. However, a couple of key usage barriers emerged throughout the interviews. These barriers can be categorized into the following two themes: **(1) training and support** and **(2) lack of necessity**. Quotes exemplifying each of these themes are presented in Table 6.

Table 6

Supporting Quotes for Themes of Usage Barriers

Theme	Quotes		
Training and Support	"If you want a skill or something you have to go in and get it. And sometimes you don't know what to ask for or- see that's why it would be fun to have a continuing- [training], 'cause you would hear what people do. And 'cause it's actually, you know, you wouldn't know if you didn't do a search. And how many of us are going to do a search?" (P3)	"I know she [Alexa] has a lot of more capabilities. Oh something about messages, which I'm not familiar with. . . . She says enter something about your computer. So I go to my computer- my smartphone, but I can't seem to get- I'm not familiar what to do. So I'm stuck on that end." (P8)	"Um and I- as I say, I think the only real challenges have been having to- I would say just having to refresh our memory if there's something we didn't use after the first introductory workshop." (P19)
Lack of Necessity	"We haven't really played music with it. I could, but we don't listen to music a lot, we watch TV a lot. . . . You know I use the phone a lot um and I use the computer for internet, shopping. . . . I mean the phone um- 'cause a lot of times when I need to check into things and that I'm away from our room, so I'll use a phone." (P9)	"Other people talk about how they get the weather report [using Alexa]. You can look out the window!" (P12)	"What I will say though that I've learned about the other technology I've done, which is phone, computers- that has become an important part of my life. I could certainly do well without Alexa. But I really depend on my cell phone. . . . I would not miss Alexa, yet. But um, but I- it's sure much easier than trying to screw around with my radio ((laughs))." (P15)

As participants in Front Porch's smart speaker adoption programs, 100% of the study's sample received some level of training and informational materials on the device. Though a few of the more tech savvy participants personally felt that their community's training was too rudimentary, the majority of participants found great value and necessity in the education they received:

“I would not know uh how to do these- that these things would even be something that Alexa would do for me had I not gone to the training sessions.” (P10)

Even with training and several months to years of usage under their belts, however, 60% of participants reported they have recently experienced trouble using a specific feature or have needed additional support to learn how to use or discover new skills. As previously discussed in section 4.4, 65% of participants desired to grow their repertoire of smart speaker usage behaviors. However, they expressed the need for external support to help refresh their memory on features they initially learned and have since forgotten and to teach them new skills that may be of interest. Notably, this challenge is also observed among young and middle-aged adult smart speaker owners in the United States, of which nearly 50% report having trouble discovering new skills (Kinsella, 2019).

While the participants found it easy to master a few key features they learned during their program's training period, their experiences demonstrate a need for continued support resources to assist with problems, answer questions, and provide novel and refresher knowledge.

Considering this finding in light of the broader population of older adults, training and support emerge as antecedents for successful smart speaker adoption. In order to obtain the gratifications uncovered in this study, the majority of older adults will likely need some level of assistance or resources readily available to help them set up and learn how to use smart speakers. However, as

today's adults, who are increasingly becoming smart speaker users with each passing year, grow older, this barrier is likely to diminish.

The second usage barrier derived from the participants' interviews is a lack of need. As reviewed, the U&G theory posits that people actively decide to use specific technologies in order to obtain gratifications that fulfill their needs and desires (Katz, Blumler, & Gurevitch, 1973). Accordingly, should a need or desire not exist, or should a technology fail to satisfy a specific need or desire, it can be assumed that the technology under question will not be used in a related manner. In fact, 60% of people who do not own a smart speaker cite a lack of need as their main reason for not purchasing the device (Schwartz, 2019).

Supporting this logic, the present study finds that participants who reported fewer usage behaviors and less frequent usage had access to other resources that helped satisfy their well-being-related needs and desires. For example, 60% of participants stated they are more reliant on their other devices, such as computers and cell phones, than on their smart speakers. This is exemplified by P5, who only uses his smart speaker for music streaming, in the following excerpt about his Apple Watch:

“Well it's [Apple Watch] got everything I want. It's got my calendar, it's got the emails, it's got voicemails . . . it's got all my steps . . . it's got EKG, which means I can set that up, put my finger on it, and it'll show my pulse as it goes. . . . I have uh news, weather, you name it! Just by hitting a different part of the watch. It is really- that is really a game changer for me. So that's why I don't need Alexa. I've got it all on my watch." (P5)

This quote demonstrates that when another technological device was already providing the participants with benefits that sufficiently met their needs and desires, they were less motivated to use their smart speakers. As P3 succinctly put it, “She's [Alexa's] more like a part of the whole.”

Apart from the presence of and preference for alternative technology, the participants' psychosocial environments, physical health, and demographic variables also impacted smart speakers' necessity in their lives. For example, the participants who felt like they had sufficient social connections and support, such as those who were living with a spouse or highly involved in their communities, were less likely to turn to their smart speakers for companionship. Similarly, the more able-bodied participants were less likely than those with physical impairments to use home automation every day. Overall, marital status, living arrangement, and health status were found to be associated with the participants' frequency and type of smart speaker usage, and thus the outcomes obtained from usage. No associations between the participants' usage and their age, sex, educational attainment, or income were found. The minority cases that emerged throughout this research could typically be explained and understood through closer examination of these contextual variables.

As previously discussed in sections 4.5.1 and 4.5.3, the majority of participants did not consider themselves dependent on their smart speakers. Despite the presence of physical, visual, and hearing impairments, the participants in this study comprise a relatively able-bodied, independent, socially connected, and cognitively healthy sample of older adults. With this in mind, it is possible that smart speakers may offer greater necessity to older adults who may have, for example, more severe physical disabilities, mental impairments, and loneliness. A broader discussion on the potential for future research to investigate this proposition further is presented in section 5.2.

It should be noted that in the existing research on smart speakers, privacy is identified as a commonly held concern and usage barrier (Figure 4). U.S. adults aged 18 or older report that worries about their personal information or private conversations being hacked or listened to

have deterred them from purchasing a smart speaker (Schwartz, 2019). Among those who do own smart speakers, perceived privacy risks are found to play a significant moderating role in dampening and negatively influencing their use (McLean & Osei-Frimpong, 2019).

Figure 4

Visualization of Smart Speakers' Privacy Concerns



Source: Roberto Parada (2018)

Even though some of the present study's participants demonstrated an awareness that others are wary about it, privacy did not emerge as a common usage barrier. This can be observed from the following exchange held with one husband and wife, who were not bothered by the fact their smart speaker may be listening to and recording their conversations:

P7: We don't know where they're storing all of our precious information.

Interviewer: Yeah, do you have any concerns about using it?

P7: Ahh no. We don't. I know some people do, yeah.

P6: She [Alexa] can listen to all my conversations if she wants ((laughs)).

Only one participant explicitly stated she personally takes privacy into consideration when using her device:

Interviewer: Do you find that you use it for some of those, you know chatting- just to chat with it or to have it tell a story or anything like that?

P2: I have done it. I've done it uh maybe a couple of times but that's one of the things that I don't know who is hearing it, and I'm a little wary of that one. I just don't feel that comfortable with it. I know it's pretty secure, um, but I just don't- when you open it up like that, and you're talking to it and it doesn't close down, you know that's when I kind of go, be careful.

While these concerns discouraged her from chatting with her device for fun, they did not preclude her from using her smart speaker for other features, such as music streaming, home automation, trivia games, asking questions, calling friends, and more. Thus, although privacy is found to be a prominent adoption and usage barrier among the broader population of U.S. adults, the vast majority of the present study's participants did not share this concern.

Collectively, these findings indicate that while there are some barriers to the participants' usage, none have been too great to inhibit them from using their smart speakers altogether. Even after owning their devices for at least six months, and in many cases much longer, 100% of participants reported they still commonly use their smart speakers for at least one feature, with 95% of participants commonly using them for two or more features. With the proper training and support, smart speakers offer promise as an easily adoptable, enjoyable, useful, and economical resource for older adults.

4.7 Summary

This chapter presented and discussed the study's findings, incorporating relevant quotes and external literature where appropriate. The U&G theory served as a framework through which to understand the participants' needs and desires and to explore if and how their smart speaker usage aligns with and gratifies them. Ultimately, the findings offer promising implications with regard to smart speakers' adoptability and usage outcomes. The following chapter presents a

summary of the study's findings and contributions, identifies future research opportunities, and elaborates on the major implications of the research as a whole.

Chapter 5: Implications and Conclusions

5.1 Contributions and Implications of Research

Within the context of an aging population, this dissertation further develops our understanding of technology's potential to support older adults' psychological well-being by looking at one promising yet narrowly researched device in particular: smart speakers. More specifically, through an interdisciplinary approach that drew together insights from psychology, gerontology, and HCI, this research explored if smart speaker usage is associated with psychological well-being among older adults. In order to meet the study's aims and address its primary research question, semi-structured interviews were conducted with 20 participants, and the Uses and Gratifications theory was leveraged as a framework through which to understand their sustained smart speaker usage motives, behaviors, and outcomes. Through its approach, this dissertation extends previous work and advances current knowledge in three primary domains.

First, this project is original in its application of the U&G theory to the study of smart speaker usage among older adults. Though McLean and Osei-Frimpong (2019) also adopted this framework for their investigation of smart speaker use, their sample did not include anyone above the age of 64. Further, their study did not address all elements of the U&G approach. Namely, they focused solely on the perceived benefits that motivate users' smart speaker adoption and neglected to examine the variables driving the desire for these benefits, the types of usage behaviors used in an effort to obtain them, and whether or not they were received through usage of the device. In comparison, this project ensured to address each of these elements in its design and analysis and thus advances our understanding of why and how people use smart speakers to satisfy specific needs and desires.

Second, this research provides rich, contextualized insights about key factors that influence the participants' psychological well-being. These insights not only contribute to the fields of psychology and gerontology, but also to gerontechnology by helping to elucidate the variables that influence the participants' smart speaker usage. While existing studies have also reported on older adults' common usage behaviors, this dissertation goes a step further by exploring the motives behind them. Specifically, the findings suggest that the participants' usage is driven by needs and desires related to their health, social relations, convenient autonomy, personal growth, and positive affect, which are found to be essential determinants of psychological well-being in the existing literature and the present study.

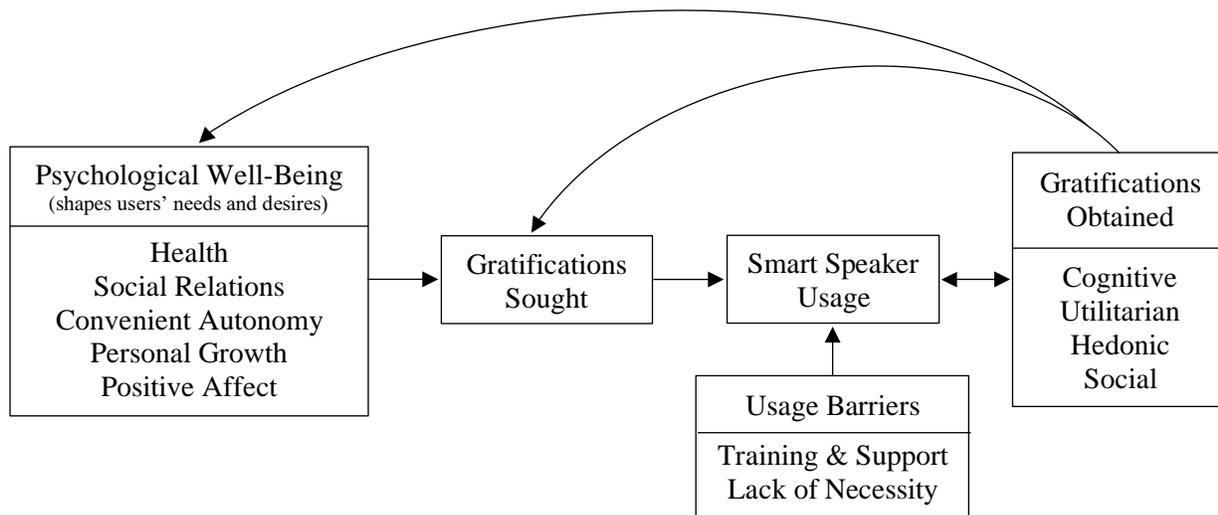
Third, and finally, this research explores the participants' prolonged smart speaker usage behaviors and their outcomes. Though a handful of existing studies have also examined older adults' use of and attitudes towards smart speakers, none of their investigations extend beyond initial adoption experiences to address sustained usage trends. Notably, the present study found that all of the participants still used their smart speakers, even after six months to two years of owning the devices. In line with the U&G theory, the participants' sustained, unremitting smart speaker use can be understood as a result of the alignment between their sought and obtained gratifications (Palmgreen & Rayburn, 1979). Beyond indicating that smart speakers have met the participants' expectations, this finding suggests the participants find value in using them. This conclusion is extensively supported throughout the participants' interviews, which revealed that through the cognitive, utilitarian, hedonic, and social benefits they offer, smart speakers help satisfy the psychological well-being-related needs and desires that motivate their usage.

Together, these findings indicate that the participants' smart speaker usage is associated with their psychological well-being in two significant ways: (1) prominent elements of

psychological well-being shape the participants' needs and desires, which motivate and influence their usage of the device, and (2) smart speakers can successfully satisfy these psychological well-being-related needs and desires through the benefits their usage offers. Figure 5 provides a simplified framework of the study's primary findings.

Figure 5

Framework of the Study's Primary Findings



Accordingly, this research holds promising implications. Though not a life-changing panacea, smart speakers may serve as an economical resource that can help sustainably support and even enhance key determinants of older adults' psychological well-being. In doing so, their dissemination may also help relieve pressure on healthcare and social resources. As such, opportunity lies in introducing more older adults to smart speakers and providing them with the support needed to successfully adopt the devices. In particular, a greater number of senior living communities could offer smart speaker devices and training resources to their residents. For older adults living outside of such communities, family members, friends, or other caregivers could assist in purchasing and setting the devices up for them. Further, this research could be leveraged by charities and nonprofit organizations to build initiatives around engaging, training,

and supporting older adults in using smart speakers. Such efforts would help increase awareness of the benefits smart speakers can provide to older adults and enhance their distribution and usage among this demographic.

5.2 Reflections and Recommendations

In light of its qualitative and exploratory nature, it is important to note that this study does not suggest a causal relationship between smart speaker usage and psychological well-being, nor are its findings generalizable to all older adults. Instead, the work laid out in this dissertation provides the instrumental, foundational insights necessary to motivate and inform the design of future research that investigates this topic further. Specifically, this dissertation sets the stage for quantitative work that can more robustly analyze smart speakers' impact on older adults' psychological well-being.

Building on the present study's findings and limitations, future work should aim to answer the following:

1. Is there a relationship between smart speaker use and psychological well-being among older adults?
2. Are different types and frequencies of smart speaker usage behaviors differentially related to aspects of psychological well-being among older adults?
3. What are the patterns of relationships among sociodemographic variables, health factors, smart speaker use, and psychological well-being among older adults?

To evaluate psychological well-being, validated scales that assess the prominent mediating variables that emerged in this dissertation could be leveraged in a survey, such as those measuring perceived health, social support, loneliness, environmental mastery, self-efficacy, personal growth, affect, and depression. With respect to the second question, smart speaker

usage behaviors could be grouped into the four categories this dissertation identified: cognitive, utilitarian, hedonic, and social. Considering the third question, future studies should control for sociodemographic variables in their data analyses to better account for the influence they have on the participants' psychological well-being.

A study with these objectives would greatly benefit from being longitudinal and quantitative in order to more thoroughly track and objectively analyze relationship patterns among a broader sample of older adults. Moreover, future work should include a sample that is not only more expansive, but also more diverse. The participants included in the present study comprise an overwhelmingly White, affluent, educated, retired, able-bodied, mentally healthy, and socially connected sample of older adults who live independently within senior living communities and received training on how to use smart speakers. Thus, further research should aim to better represent the broader population of older adults, which is highly diverse.

In particular, opportunity lies in including older adults with more severe disabilities, impairments, and social isolation, older adults who have remained in their homes, and older adults who have not received any smart speaker training or support. Considering the first group, the findings from this study offer some promising implications, though the presence of limited and deviant cases necessitates further inquiry. Next, research examining community-dwelling older adults may provide important insights regarding smart speakers' potential to support aging in place. Lastly, the final group would help determine how necessary training and support are to older adults' successful adoption of smart speakers, sustained use of the devices, and receipt of the potential usage benefits that were identified in this research. Inclusion of the latter two groups would also help explore whether the well-being outcomes observed in this study were

more influenced by the participants' residence within senior living communities and participation in training sessions than by their smart speaker usage.

Subsequent research should also seek to understand any possible negative outcomes that might arise from smart speaker usage among older adults. In general, studies have found that an overreliance on technology to meet specific needs can lead to adverse effects, such as lowered self-esteem, life satisfaction, and happiness and increased loneliness, anxiety, and depression (Twenge, 2019; Twenge et al., 2018). Though moderate smart speaker use is not likely to cause any significantly negative impacts on older adults' psychological well-being, an overdependence on the devices may. With this in mind, smart speakers should be viewed and implemented as an auxiliary resource, not as a replacement for human support and connection.

5.3 Concluding Remarks

This dissertation contributes to the fields of psychology, gerontology, and gerontechnology by providing an in-depth look at psychological well-being and technology usage in later life. While limited in scale, it offers nuanced, foundational insights into the potential smart speakers may hold for the lives of older adults. On a broader level, this research also has important societal implications. As the population continues to grow older, devices like smart speakers may help relieve some of the anticipated strain on healthcare and social resources by improving older adults' psychological well-being and mitigating their need for external human support. Overall, this dissertation helps advance the discourse and set the stage for future research examining well-being at a time when the world is continuously growing older and becoming more digitally connected.

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Appendix A: Interview Guide

Contextual information about the interview and the interviewee

- Date of the interview:
- Place of the interview:
- Duration of the interview:
- Indicator for identifying the interviewee:
- The interviewee's gender:
- The interviewee's age:
- Living arrangement:
- Marital status:
- Income:
- Educational attainment:
- Profession:
- Number of children (if any):
- Social contacts with family:
- Other:

RAPPORT QUESTIONS

1. Tell me a little about yourself.
2. How long have you been living at X?
3. What brought you to live here?

I) PERCEPTIONS AND EXPERIENCES OF WELL-BEING IN LATER LIFE

1. Generally, how has aging/getting older been for you?
2. From your experience, what are the most important things that make you feel happy and well in life?
3. Do you think this is true for most older adults? What other sorts of elements do you think contribute to well-being in later life?
4. What are your main needs and desires?
5. What are some of the greatest challenges you face on a daily basis?
6. What are the main problems or barriers that affect your well-being? Are you able to overcome them?
7. Do you spend time with family or friends often?
8. Overall, how would you consider your health? What sorts of daily physical challenges do you encounter?

II) INITIAL MOTIVATIONS FOR USING AND EXPERIENCES WITH SMART SPEAKERS

1. How did you get involved in the Alexa program initially? What motivated you to initially want to participate in the program?
2. About how long have you owned the device? Do you also have home automation technology hooked up in your home?
3. What sorts of features or perceptions of the device attracted you to it initially?
4. At the beginning of the program, did you have any concerns or hesitations about using the device?

5. Tell me about your experience with the program and using the device.
6. During the program, do you remember in what sorts of ways you were using the device?
7. Initially, did you encounter any specific challenges when using the device?
8. Overall, what were your perceptions of the device? Things you liked? Things you didn't?

III) SUSTAINED SMART SPEAKER USAGE MOTIVES AND BEHAVIORS

1. Do you still use your device? In the past week, how often would you say you used the device?
2. In what ways do you typically use your device? In the past week, in what sorts of ways did you use your device?
3. Have you noticed that your engagement with the device has changed over time?
4. Do you ever use your device to communicate with others? For example, to stay in touch with friends, family, or others in your community?
5. Do you have any unique skills installed on your device?
6. What features of the device do you find the most helpful?
7. Do you still encounter any challenges when using the device? Anything you wish the technology did better?
8. Now that the device has been a part of your life for a while, what are your overall perceptions of it? What do you like best about the technology? What do you dislike?

IV) GRATIFICATIONS/OUTCOMES FROM USING SMART SPEAKERS

1. Would you say the device has changed your daily life in any way?
2. Does the device help you overcome any particular challenges?
3. Does the device help you fulfill any specific needs or desires?
4. How would you say the device has been the most helpful? The least?
5. Would you recommend the device to other older adults? Why?

Appendix B: Information Sheet

Project Title: *Smart Speaker Use and Psychological Well-Being Among Older Adults*

You are being invited to take part in a research study. Before you decide whether to participate, it is important to understand why the research is being done and what it will involve.

Purpose of the study

The goal of this study is to investigate how older adults are using smart speakers and whether using these devices can lead to positive well-being outcomes. This investigation is part of an MPhil research project in psychology at the University of Cambridge. By participating in this study, you will help contribute to a growing body of research seeking to understand ways in which to maintain and improve psychological well-being in later life.

What does this research involve?

You are being asked to take part in this research due to your previous participation in an Amazon Alexa program and your ownership of a smart speaker device. If you decide to participate in this study, your contribution will consist of one qualitative, semi-structured interview with the primary researcher. The interview will likely last between 30 and 60 minutes and will be audio recorded. Questions will be open-ended to learn about your perceptions of well-being in later life and your experiences with smart speakers. Taking part in this study is entirely voluntary, and you are free to withdraw at any time without explaining why.

Will my identity be kept confidential?

Your privacy is very important. Therefore, no one apart from the primary researcher will have access to any personally identifiable data. The information you share will be treated confidentially, which includes the changing of your name and specific information that could identify you, both in the interview transcripts and the final dissertation. For further general information about the University of Cambridge's use of your personal data as a participant in a research study, please see <https://www.information-compliance.admin.cam.ac.uk/data-protection/research-participant-data>.

What will happen to the results of the research project?

This study is expected to conclude in September 2020. At this time, a dissertation including the findings from the interviews will be handed into the Department of Psychology at the University of Cambridge for review. Data gathered in this study may be stored anonymously and securely and may be used for future academic research, however, no data will be kept for longer than necessary.

Ethical review of the study

This project has undergone the review procedure of the Department of Psychology Research Ethics Committee at the University of Cambridge.

What if I have any more questions?

This study is organized in the Department of Psychology, University of Cambridge, by Brenna Budd. If you have more questions, you can discuss them with her during the interview, or contact her any time by email: beb32@cam.ac.uk.

Appendix C: Consent Form

- I confirm that I have read and understood the information about the study.
- I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.
- I understand that all personal information will remain confidential and that all efforts will be made to ensure I cannot be identified.
- I agree that data gathered in this study may be stored anonymously and securely and may be used for future academic research.
- I agree that this interview can be recorded.
- By signing my name below, I agree to take part in the study.

Signature

Date

Appendix D: Debrief Form

Thank you for participating in this study. I will now explain a bit about the background and aims of the research.

Background Information

A growing body of research investigating the potential digital technologies hold for maintaining and enhancing psychological well-being in later life has emerged. Previous studies have found a relationship between information and communications technology, such as the internet and social media, and positive well-being outcomes, such as higher levels of self-efficacy, life satisfaction, and perceived social support. To date, few studies have examined the impact voice technologies, such as smart speakers, may hold for older adults. As such, this study aims to understand how older adults are using smart speakers and if their usage is related to various well-being outcomes.

Methodology

In order to investigate these research questions, I am conducting a series of interviews. Interviewees are individuals who previously participated in smart speaker programs within their senior living community and who personally own smart speaker devices. The interviews consist of open-ended questions aimed at understanding participants' perspectives on the elements that contribute to well-being in later life, major challenges that interfere with well-being, how smart speakers help address these challenges, what smart speaker features are driving usage, and how smart speakers have or have not contributed to the daily lives and overall well-being of older adults. Following these interviews, participants' responses will be coded for key themes related to the elements considered important for psychological well-being in later life, smart speaker usage behaviors among older adults, and the outcomes of these usage behaviors. The open-ended questions are preceded by demographic questions to understand how different backgrounds might contribute to and explain variations in participants' responses.

Expected Results

When coding the interviews, I predict that such elements as companionship, social connectivity, independence, and environmental mastery will emerge as key themes related to psychological well-being in later life. Additionally, I predict the interviews will reveal that smart speakers are being used by older adults in a way that mirrors these themes. In other words, I expect that older adults' usage behaviors will fall under two main categories: social and utilitarian. Social here is used to classify the use of smart speaker features that facilitate communication, social connection, and companionship, and utilitarian here is used to classify the use of smart speaker features that help users to efficiently complete tasks and control their environment. Overall, I expect to find that smart speaker usage will reflect users' desire to fulfill specific social and psychological needs comprising their well-being.

Importance of Research

Estimates show that the global population is growing older. This trend presents compelling challenges when considering how efforts can be enhanced to support an aging society. As greater numbers of people are living longer, it is imperative to understand how technology may help maintain and even improve older adults' well-being.

Additional Resources

If you would like to learn more about the topic of this research, you might find the following literature of interest:

- Erickson, J., & Johnson, G. M. (2011). Internet Use and Psychological Wellness during Late Adulthood. *Canadian Journal on Aging*, 30(2), 197–209. doi: 10.1017/s0714980811000109
- O'Brien, K., Liggett, A., Ramirez-Zohfeld, V., Sunkara, P., & Lindquist, L. A. (2019). Voice-Controlled Intelligent Personal Assistants to Support Aging in Place. *Journal of the American Geriatrics Society*, 68(1), 176–179. doi: 10.1111/jgs.16217
- Reis, A., Paredes, H., Barroso, I., Monteiro, M. J., Rodrigues, V., Khanal, S. R., & Barroso, J. (2017). A Prospective Design of a Social Assistive Electronic System for the Elderly. *Advances in Science, Technology and Engineering Systems Journal*, 2(3), 1665–1669. doi: 10.25046/aj0203207

If you have any questions about the study, feel free to contact the primary researcher, Brenna Budd, by email: beb32@cam.ac.uk.

Thank you once again for your help with this research!

Appendix E: Excerpts from Research Diary

Case Studies

→ Single concrete terminal, good health (P1)

well-being: activity (involvement in community, learning/personal growth), conv/cont/env mastery (life made easier, external support, quality of life, being in control/autonomous), social relations (social ties), Connection to world (staying current & aware)

• usage behaviors + great enjoyment

→ men + women re: time
 Information retrieval
 Spelling
 time
 Calendars/scheduled maintenance
 home automation

→ news
 weather
 traffic reports

→ music - hedonic → positive affect

→ Chatting
 Calling feature → social → social relations + companionship

→ other:

→ post. in program = involvement in community = activity
 → mastery of device = connection to world + self-esteem
 → post. in program = social - helps others of theirs & helps about it w/ others

* Summary: mostly about convenience & companionship but receives all these other gratifications as well, which may have to the variables she perceives as important to her psychological well-being

with some health/mobility issues

→ Married Couple Living Together (P6 & P7)

• well-being: social relations (each other, others in community), Activity (involvement in community), conv/cont/mast (quality of life, personal support), Positive affect (positive attitude), Connection to world

• Usage behaviors + obtained gratifications

→ home automation w/ hints
 lists
 time
 asking questions
 weather

→ music - hedonic → entertainment/recreation/pass time/positive affect

→ Chatting - hedonic + social → positive affect/fun + companionship

→ other:

→ mastery of modern tech allows for connection to world
 → Alexa helps make life easier in light of mobility/health impairments
 → program previous dialogue of long shopping list

* Summary: find Alexa fun & functional for them. In light of declining facilities/mobility, Alexa helps make life easier & is very utilitarian. She also helps make these non-tech-savvy older adults feel connected to the world & for him who is more apt-bound, adds element of fun & companionship