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The Utility of Smart Home Technology within Occupational Therapy Practice

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by

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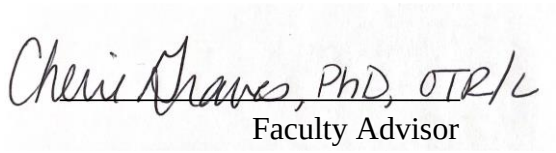
Approval Page

This Independent Study paper, submitted by Kylie Walthers, MOTS and Jessie Zimmer, MOTS in partial fulfillment of the requirement for the Degree of Master of Occupational Therapy from the University of North Dakota, has been read by the Faculty Advisor under whom the work has been done and is hereby approved.



Faculty Advisor

April 16, 2020

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PERMISSION

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ABSTRACT

Title: The Utility of Smart Home Technology within Occupational Therapy Practice

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Purpose: The purpose of this study is to explore occupational therapist practitioners' (OTPs) utility of smart home technology (SHT) in their practice, as well as to inquire into the facilitators and barriers of utilization of smart home technology within the practice of occupational therapy.

Methodology: This study was approved by the Institutional Review Board at the University of North Dakota (UND) in Grand Forks, ND. A quantitative, descriptive research design utilizing survey methodology was used. Recruitment was conducted through purposive and convenience sampling. A 30-question Qualtrics survey was distributed to participants via social media and internet pages (OT4OT; AT4OT; CommunOT; and UND OT Alumni page). There was minimal inclusion criteria for the population recruited. Quantitative data was analyzed using the Statistical Package for Social Sciences, version 26. The framework guiding this quantitative research study was the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Venkatesh, Thong, & Xu, 2012).

Results: A total of 75 surveys were returned, both by occupational therapists (OTs) and occupational therapy assistants (OTAs). Most of the respondents were female (91%, *n*=68) and were OTs (85%, *n*=64). Most of the respondents practice in the United States (61%, *n*=46) working in home health (33%, *n*=25) and outpatient settings (31%, *n*=23). Overall, the respondents reported that they do not currently use SHT in practice (63%, *n*=47), that they are somewhat interested in using SHT (34%, *n*=21), and that most of their education on SHT is obtained from independent research or study (25%, *n*=16). When considering availability, respondents stated that they do not have time (57%, *n*=43) or access (36%, *n*=22) to incorporate SHT. Lastly, available funding and support are limited as well, with respondents stating they do not have employer (85%, *n*=52) or other funding (52%, *n*=31). Most non-financial support comes from co-workers (*n*=16) and family (*n*=8). Spearman *rho* correlations were conducted, finding multiple strong correlations between: the degree of support and who is providing the support (co-workers, family, etc.); level of comfort with utilizing SHT and effectiveness when utilizing SHT; types of funding sources available (private, insurance, etc.) and received amount of funding currently; and received funding and use.

Conclusion: Occupational therapy practitioners are more likely to use SHT in practice if they have support in a variety of forms, but especially from their co-workers. Interest is also linked to increased support, increased access to funding, and increased availability. However, interest was not the driving force for being effective when using SHT. It was found that comfort with SHT was the driving force for practitioners to perceive they were effective when using it as an intervention. The most substantial barriers to using SHT that were identified include: lack of funding sources, lack of education, and lack of

availability to the devices. These factors do not need to remain barriers and in fact can and should become supports to using SHT. Smart home technology should be used in care and when a practitioner takes a moment to develop interest in the topic, thus developing a better understanding and knowledge base, they will likely have an increase in comfort and therefore, perceived effectiveness when using technologies as interventions. All of these factors assist clients in the long run.

CHAPTER I

INTRODUCTION

Rationale

Smart home technology (SHT) is becoming a popular means to assist people in their daily lives. Various populations may benefit from the use of SHT including individuals living with disabilities, individuals that wish to age in place, as well as the general population. Smart home technology can arguably fall into the category of assistive technologies (Cook & Polgar, 2014) and therefore can be used by occupational therapy practitioners (OTPs) for therapeutic interventions. There have been calls to action for OTPs to be using SHT (Waite, 2015) and studies that look at the feasibility of OTPs using SHT to assist client's to live more independent and meaningful lives (Giger & Markward, 2011; Liu, 2018). Despite this, little research has been done investigating OTPs actual use of SHT and the barriers and supports that OTPs experience influencing their use or non-use of SHT.

Theoretical Framework

The framework that was used to guide this quantitative research study was the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Venkatesh, Thong, & Xu, 2012). The Unified Theory of Acceptance and Use of Technology 2 is a theory developed by information systems researchers (Venkatesh et al., 2012). This is an expansion of the Unified Theory of Acceptance and Use of Technology (UTAUT) (Liu et al., 2015; Venkatesh et al., 2012). The UTAUT2 considers individual characteristics (age,

gender, and experience) and constructs (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit) when assessing and observing the influence on the consumer's behavioral intention and behavioral use of technology (Venkatesh et al., 2012). This model has been used in the past to study the acceptance of new technologies by rehabilitation therapists (Liu et al., 2015). The Unified Theory of Acceptance and Use of Technology 2 is a well-suited theory to utilize when examining the relationship of occupational therapy practitioners and their integration of SHT into practice due to its extensive nature as it looks into individual characteristics and constructs, and how these may influence the utilization of technology in occupational therapy practice. The model was chosen when considering previous literature that was available on the use and non-use of technology and was determined by the researchers to be a good fit to guide the research process.

Statement of the Problem

Occupational therapists have the opportunity to assist individuals to live independent and high quality lives through the use of SHT. To further explore the use of smart home technology in occupational therapy practice, the researchers designed this quantitative study. The overarching research question is, what is the utility of smart home technology within occupational therapy practice? The researchers developed two additional sub-questions:

- What relationships exist (if any) between factors identified and reported with use of SHT?
- What relationships exist (if any) between factors identified and reported with perceived effectiveness with SHT?

Assumption

Based on the literature review and personal experience, the researchers assumed that there would be minimal use of SHT by practitioners. In addition, the researchers assumed that there would be several factors that have influenced the use or non-use of SHT by OTPs. Factors that were thought to influence use include but are not limited to availability, funding, and support.

Scope and Delimitation

This study was granted approval by the University of North Dakota's Institutional Review Board. The data for this study was gathered via an online survey. Participants were recruited via social media and online discussion boards. Inclusion criteria for participants required the individuals to be occupational therapists or occupational therapy assistants. The survey tool was open for five weeks before being closed for data analysis.

Importance of the Study

Little research has been done looking at the actual use of SHT by occupational therapy practitioners and potential facilitators and barriers of using this technology. This study shows the importance of occupational therapy in this new realm of technologies. In addition, this study provides objective information regarding why practitioners may not be using SHT in practice. This information is relevant and important to occupational therapy practitioners, occupational therapy programs, assistive technology companies, SHT companies, and consumers of occupational therapy services.

Definition of Terms

The following terminology is used throughout the remainder of this scholarly project.

- ***Assistive technology*:** "A broad range of devices, services, strategies, and practices that are conceived and applied to ameliorate the problems faced by individuals who have disabilities" (Cook & Polgar, 2014, p.460).
- ***Occupational therapy practitioners:*** For the purposes of this study, occupational therapy practitioners (OTPs) are defined as occupational therapists and occupational therapy assistants.
- ***Smart home technology:*** "Any electronic device (including but not limited to actuators, sensors, computer processors/software, and supporting structures) that create an integrated system capable of monitoring and supporting individuals in real-time" (Davenport, Mann, & Lutz, 2012, p. 169).

CHAPTER II

REVIEW OF LITERATURE

Technology has become a part of our lives more now than ever before. It has become embedded within the way people live and work, and even within people's bodies and what they choose to wear (Liu, 2018). There is a variety of different forms of technology, ranging from robotics, the Internet of Things (IoT), artificial intelligence (AI), 3-D printing, virtual reality, autonomous vehicles, smart home technology, and much more (Liu, 2018). With the increase of technology in everyday life comes the increase of opportunities that individuals can utilize technology in assisting with healthcare. These technologies can be used to assist individuals with and without disabilities in a variety of ways. According to Liu (2018), healthcare professionals, including occupational and physical therapy practitioners, were initially slow to use technology in the rehabilitation process. However, throughout the years, healthcare practitioners have increased their overall use of technology when providing services for clients.

When faced with the idea of implementing technologies into healthcare, many individuals, practitioners and clients alike, quickly revert to the idea of assistive technologies. Assistive technology encompasses devices, services, and systems that assist individuals living with a disability to perform designated tasks throughout their everyday lives (Cook & Polgar, 2014). Assistive technology falls into two categories, high assistive technology and low assistive technology. *High* technology involves more complex

devices, such as augmentative and alternative communication devices, whereas *low* assistive technology devices involve less moving parts, such as Velcro straps or built up utensil handles.

A more recent form of technology, smart home technology (SHT), has added greater opportunities for occupational therapy and other professions. While the promise of smart home technology in rehabilitation fields is great, the complexity of use has contributed to its slow rise in popularity and slower rate of implementation in practice. In Sweden, researchers studied the SmartBo project, which utilizes solutions for elderly with mobility and/or cognitive impairments. Solutions involve utilizing devices and sensors that control the lighting, windows, doors, locks, water outlets, electrical power and stove. In addition, visual and tactile signaling devices, Braille displays for the visually impaired, and speech synthesizers were incorporated (Demiris et al., 2004). These examples of technology demonstrate how technology can be utilized by healthcare practitioners to enable a variety of clients to improve their overall functioning and well-being in the home environment.

These technological advances have brought about opportunities that occupational therapists can utilize to support client occupational performance and participation. To have an impact in the realm of advancing technologies and in the future trends of client care, the occupational therapy profession must understand the technology available and how it can be used to support client occupational performance and participation. The scope of technology is extensive and can include many different devices, terminologies, and definitions. The focus of this inquiry is on the use of smart home technology in occupational therapy practice.

What is Smart Technology

There are many definitions of smart technology. Davenport, Mann, and Lutz (2012) define smart technology as "any electronic device (including but not limited to actuators, sensors, computer processors/software, and supporting structures) that create an integrated system capable of monitoring and supporting individuals in real-time" (p. 169). According to Dermody and Fritz (2019), smart home is a general term used in two ways: "when referring to consumer-driven in-home smart products (e.g., Amazon's® Alexa), or when referring to technology that assists with in-home delivery of healthcare aging-in-place technologies such as Life Alert®, AngelSense®, GPS Smart Sole®" (p. 2). Data collected from smart home technology can consist of many things, such as dates, timestamps, sensor labels (e.g., bedroom, a door), sensor states (e.g., ON/OFF), and activity labels (e.g., sleeping, grooming) (Dermody & Fritz, 2019). Within this paper, smart technology and smart home technology will be used interchangeably.

Designing a Smart Home and Available Technology

Smart home technology uses two different approaches to provide services; distributing direct sensing and infrastructure-mediated sensing (Chung, Demiris, & Thompson, 2016). Distributed direct sensing uses installed sensors in the home for indicators, whereas infrastructure-mediated sensing uses sensors that are already in place, such as an air conditioner or electricity use, to sense activity levels within the home (Chung et al., 2016). These approaches need to be taken into consideration when designing a smart home system. A smart home system uses multiple smart technologies within a home's IoT system to assist an individual in their desired areas of services indicated by the type of technologies introduced into the home.

To begin the design process of a smart home system, the home's Wi-Fi needs to have the capability to support the technology. More than one router may be needed depending on the size of the home and the technologies being used. A mesh Wi-Fi system uses multiple devices to provide Wi-Fi in all areas of the home, including near the home's parameters to allow Wi-Fi to work outside the home (McKeough, 2019). Once the initial stages of setting up the system(s) have been addressed, there are several options to control the smart home system. Individual devices can be controlled by individual apps from a smartphone. Many companies have apps that allow controls to be used across the company's specific devices. A virtual assistant is also able to control basic features, such as turning the lights on and off or controlling a thermostat (McKeough, 2019). For a more comprehensive control system, a smart hub or bridge is used. A hub and bridge offer the same services, which is to connect all smart technologies in one place (Apple Inc., 2019; McKeough, 2019; Smart Home, 2019). This allows for complete control from a single app. With a hub or bridge, an individual is able to set up specific controls that can occur daily, such as low lighting when people arrive at home in the evening or setting the sprinkler system to turn on at a certain time. In essence, a hub or bridge allows an individual to easily access all of the abilities and services technology has to offer from a single app. Hubs and bridges are able to connect with voice assistants as well (Apple Inc., 2019; McKeough, 2019; Smart Home, 2019).

Voice assistants are likely one of the most popular smart devices that are currently available. There are several prominent companies that make voice assistants that also make other smart technologies, allowing for ease of interconnection between the technologies. Voice assistants are able to play music, answer questions, and give

reminders, among other things (McKeough, 2019). Smart speakers can connect with a central voice assistant to provide the services throughout the home (McKeough, 2019).

Smart home technology is able to address almost all aspects of the modern home, from security, to lighting, to water leaks. Security systems use door sensors, door locks, motion sensors, and video monitoring to notify an individual of any changes in the environment as well as allow access to the home (Apple Inc., 2019; McKeough, 2019; Smart Home, 2019). These devices can be used throughout the home, as well as outside. For example, a smart doorbell can be used to monitor who enters the home or who is near the front of the house (McKeough, 2019). Smart sprinkler systems are also available, allowing a person to turn on the sprinklers at home from anywhere in the world (Apple Inc., 2019; McKeough, 2019; Smart Home, 2019). Smart garage doors are a common feature in smart homes as well (McKeough, 2019).

Inside the home there are a variety of technologies that can sense the air, turn on the lights, and monitor for potential issues (Apple Inc., 2019; McKeough, 2019; Smart Home, 2019). Smart lighting can be achieved by installing a bulb or a dimmer (McKeough, 2019). Battery powered window shades are able to work with shades that are already existing in the home (McKeough, 2019). Smart outlets are also available to assist in turning on or off appliances that are plugged in, even those that are not considered to be a smart device (Apple Inc., 2019; McKeough, 2019; Smart Home, 2019). Smart TVs connect to an online network to allow web access and network channels without the need for cable or satellite. In the area of home safety and comfort, the following smart devices are available: fans, thermostats, air purifiers, humidifiers, smoke and carbon monoxide detectors, water leak detection, kitchen appliances, washing

machines, access control, and additional indoor sensors (Apple Inc., 2019; McKeough, 2019; Smart Home, 2019). For many of these devices, individuals, including professionals and clients alike, forget that the devices are considered SHT.

Using Smart Home Technology to Enhance Quality of Life

Smart home technology is used globally by individuals with and without disabilities. It is considered assistive technology if it is used specifically to assist an individual with a disability to complete everyday tasks. For example, SHT can be used to assist an individual who has a cognitive impairment to remember to take their medications in the morning. A SHT system can be developed to enable an older adult to age in place safely and negate the necessity of facility placement.

Currently, there are several companies that provide services targeting older adults and their loved ones who wish to age in place. Aging in place services are made possible by use of a variety of sensors, video monitoring, artificial intelligence, two way communication systems, and voices assistants (Orlov, 2019). These technologies are able to: detect falls, provide reminders, monitor for safety and security, provide communication with healthcare professionals, call emergency services, communicate with family, allow for family to check in with their loved ones, and even monitor cognition (Orlov, 2019). These services may also be an option for individuals of any age, with disabilities, to live more independent lives.

In addition to using SHT to age in place at home, smart technology is being made available to use in facilities such as long term care and assisted living (WytCote Technologies, 2019). Various sensors, wearable technology, and video monitoring can

detect movements and actions of residents and staff, fall detection, and facility operations, such as moisture and water temperatures (WytCote Technologies, 2019).

This technology is able to provide services and support in many parts of home life. Smart devices are able to assist individuals with all ability levels and needs, and can provide huge advancements in care when implemented with rehabilitation services. Smart home technology is likely to be more interconnected and an accepted part of society as it becomes more advanced and popular, essentially in all aspects of our daily lives and environments. Occupational therapy practitioners must follow the trend of technology and the opportunities it can provide, such as promote client well-being and connect clients to individuals or systems when needed most. There is a considerable amount of literature that examines use and non-use of assistive technology devices, among users and practitioners, but literature is lacking specifically related to use and non-use of smart home technology. There is a need for further study on SHT and the factors influencing the implementation of such devices among practitioners into client's everyday lives.

The Occupational Therapy Process: Incorporating Technology

Technologies are influencing our future and will pose new ways for occupational therapy practitioners to assess and provide intervention services to clients. With the continued development and increased use of technology devices, it is likely that the role of occupational therapy and other interdisciplinary team members in relation to technology will also continue to grow (Verdonck, McCormack, & Chard, 2011). Occupational therapy practitioners have many different ways they can incorporate technologies to help clients, such as critically analyzing the details and skills needed to use technology, choosing and implementing the appropriate technologies for use outside

of a clinical setting (ex. work, home), or being a part of a research team that researches updated technologies (Cook & Polgar, 2014).

When examining an OTs role as part of a research team, Alex Mihailidis - the Barbara G. Stymiest Research Chair in the rehabilitation technology center at the University of Toronto and Toronto Rehab Institute - conducts research on pervasive computing and intelligent systems used in healthcare. Along with one of his team members, who is an occupational therapist, Alex states that "their primary role is making sure that we understand the human roles for the technology, looking at the functionality based on the needs and the skills that the particular client has - the OT really has that lens" (Waite, 2015).

Ultimately, the goal of occupational therapy when working with clients who are considering the implementation of home modifications and SHT is to help client's be as safe and independent as possible, allowing the client to engage in the activities and tasks that are meaningful to them (Waite, 2015). The intent for many occupational therapists when considering the implementation of technology is to meet individual's needs and desires to remain independent in their home environment, leading to the use of smart home technology. With the increase in utilization of smart home technology in healthcare, it is important to consider what the needs of the client are, which is obtained through the occupational profile and occupational therapy evaluation, and the expectations of the individual in regards to technology usage (Cook & Polgar, 2014). If occupational therapy practitioners fail to take the needs of the client into consideration while implementing the devices or systems, by only considering the direct features of the

technology, they risk adopting approaches that are associated with medical, bottom-up approaches, and disempowering the client (Cook & Polgar, 2014).

There are many examples in the literature that support the occupational therapy profession in helping clients who are using smart technology. Occupational therapy practitioners have the ability to provide interventions in the area of smart technology for a variety of clients in a wide array of contexts. The following are examples from the literature of utilizing smart technology for interventions. Occupational therapists can use compensatory strategies with censored eyewear for left inattention poststroke and use of interactive games with older adults to understand the functions within a home or community (Giger & Markward, 2011). There are also devices that assess levels of engagement in clients who are nonverbal or unable to complete traditional assessments that measure engagement and alerts on mobile devices for community citizens when a person, such as an older adult with dementia, goes missing from or within a geographical location (Giger & Markward, 2011). In regards to smart home technology and occupational therapy, occupational therapists design smart homes to allow clients to remain in their natural environments by utilizing universal design principles and implement smart home monitors to assess client's abilities to complete activities of daily living (Giger & Markward, 2011). In addition, occupational therapists can recommend SHT in the homes of individuals with serious mental illness or cognitive impairments to assist caregivers in monitoring for safety and to assist these individuals in leading more independent lives by providing reminders, safety alerts, and monitoring (Giger & Markward, 2011).

With the increasing development and utilization of smart home technology in healthcare, users currently experience challenges such as continuously developing and maintaining their knowledge of options, implementation, and maintenance of this type of technology (Verdonck et al., 2011). In addition, occupational therapists experience challenges with maintaining a client-centered focus, limiting abandonment of the devices, and keeping up to date with the emerging products (Verdonck et al., 2011). Occupational therapists must be aware of and consider the way technologies have changed how basic and instrumental activities of daily living are performed, making some OT assessments obsolete (Liu, 2018). Occupational therapists delivering occupation-focused and person-centered services while utilizing smart home technologies need to know what is available and how to access and use the technologies with clients. Some common barriers, or challenges, with implementing technology into OT care will be addressed within the next sections.

Factors Influencing the Implementation of Smart Home Technology

Literature supports the use of SHT for improving the lives of clients (Davenport, Mann, & Lutz, 2012), recognizing the impact technology can play in improving an individual's quality of life. With that said, the researchers of this study assert that occupational therapist's experience factors that influence the implementation of smart home technology. A small-scale study conducted in Ireland explored occupational therapist's responses to a short, five-question survey related to their views on utilizing technology, perceived competence in this area, and an understanding of whose role it is to assess for and prescribe such technologies (Verdonck et al., 2011). The researchers found benefits that occupational therapist's identified when using advanced technologies in

client care. These benefits include improved client independence, increased client self-esteem, increased participation in occupations, improved personal relationships, increased safety, decreased level of assistance needed, and overall the technology saved money for the client and the company (Verdonck et al., 2011).

Although there are benefits to utilizing SHT, there are identified factors that influence the implementation of technology. Hoogerwerf et al. (2002) assert that *high* technologies, such as SHT, is described by practitioners as inconsistent, uncoordinated, fragmented, and difficult to access. Although Hoogerwerf et al. (2002) was published almost two decades ago, the researchers assert that these descriptions by practitioners in regards to technology likely remain similar today, even with the considerable advances in technology. Additional factors have been identified in the literature as either supporting or inhibiting the use of SHT. These variables include knowledge (Dicianno et al., 2019; Hamblin, 2017; Jiancaro, Jaglal, & Mihailidis, 2017; Kumar et al., 2013; Proffitt, Schwartz, Foreman, & Smith, 2019; Verdonck et al., 2011), personal interest (Verdonck et al., 2011), workplace culture (Proffitt et al., 2019), and funding (Assistive Technology Industry Association, 2019; Berridge, 2018; Dicianno et al., 2019; Hamblin, 2017; Haymes, Storey, Maldonado, Post, & Montgomery, 2015; Verdonck et al., 2011). The researchers assert that access and time are additional factors that support or inhibit the use of SHT by healthcare professionals, although further research is needed to add to the insight of how access and time affect occupational therapy practitioner's use of SHT.

Knowledge

Knowledge is a necessary component when it comes to implementing any type of intervention. In the case of SHT, there is conflicting literature regarding the knowledge

base that occupational therapy practitioners have when it comes to specialized technologies. There is literature that supports the knowledge and skill set of occupational therapy practitioners in the use of SHT in practice (Proffitt et al., 2019). Despite that, additional literature suggests that occupational therapy practitioners have limited knowledge in incorporating SHT into interventions and practice (Dicianno et al., 2019). Proffitt et al. (2019) emphasized the importance of contributing to research and development in disability-related technology designs. These contributions can be made by occupational therapists. Occupational therapists have the skill set and knowledge in the areas of research and universal design, which is a common approach that is encouraged when engineers and designers are creating technologies. Universal design requires the expertise of practitioners and professionals who understand all types of disabilities and impairments, and how to represent individuals with these disabilities when utilizing technologies for functional tasks (Proffitt et al., 2019).

Limitations of knowledge are also represented in the literature. Although there is support for occupational therapists to be involved in disability-related technology designs (Proffitt et al., 2019), there seems to be a lack of knowledge among other working professionals when it comes to incorporating occupational therapists roles in technology design. The lack of provider knowledge, whether it be about the technology or the provision process itself, commonly arises (Dicianno et al., 2019). One barrier that occupational therapists can encounter is a "language barrier". Engineers and computer scientists, as well as occupational therapists, all have their own jargon, creating difficulties for professionals to communicate effectively about potential collaborations when implementing technologies (Proffitt et al., 2019). Another barrier addressed in

current research is that consumers of the technology, such as occupational therapists and other healthcare professionals, are not waiting for scientific approval before utilizing these technology-based interventions (Kumar et al., 2013). This indicates a potential misuse of technology, such as using tech when it is contraindicated for a client.

Jiancaro, Jaglal, and Mihailidis (2017) surveyed professionals within the fields of occupational therapy, medicine, and psychology. According to the survey results, there needs to be a larger role for clinical specialists (such as fields mentioned above) to introduce and guide practice through models that may help frame and specify a situation in which technological interventions would be appropriate. This can be done by educating the clinical specialists. Participants in the survey also indicated that they would be interested in becoming more educated in this area and could see potential value in learning and utilizing technology-specific models (Jiancaro et al., 2017). According to Verdonck et al. (2011), 84% of occupational therapists believed that he or she should be able to assess for and prescribe higher technologies; however, only 34% were able to do so. The researchers suggested that this difference may be attributed to lack of opportunity to be involved during this aspect of care, and/or having little training and knowledge in this area (Verdonck et al., 2011).

Personal Interest

Occupational therapy practitioners have a unique role in mainstreaming the use of technologies into the delivery of client care. In addition, practitioners may take on the role of supplying and maintaining the technologies, which may range from low tech to high tech devices, including smart home technologies (Verdonck et al., 2011). In order for an occupational therapy practitioner to build knowledge about SHT, some personal

interest in technology and incorporating it into practice is needed. Practitioners that are more interested in the subject have a greater potential for incorporating the technology into the intervention process (Verdonck et al., 2011). According to Verdonck, McCormack, and Chard (2011), occupational therapists indicated that professionals that provide specialized technologies are not exclusive to specialized practitioners, such as assistive technology practitioners. Instead, the respondents indicated that they were interested and capable of incorporating specialized technology (Verdonck et al., 2011).

Workplace Culture

When considering the occupational therapy profession, workplace culture can be viewed as a factor that starts as far back as our educational programs. Students are shaped by their educators, fieldwork instructors, and other OT students who have been in the field (Proffitt et al., 2019). Proffitt, Schwartz, Foreman, and Smith (2019) suggests students have experiences and opportunities to collaborate with other professionals that may be implementing technologies with clients or creating designs for technologies, such as engineering and design peers (Proffitt et al., 2019). Another recommendation provided by Proffitt et al. (2019) is providing administrative leadership to support the role of occupational therapy in technology research and development. There are special interest groups among the American Occupational Therapy Association, webinars, articles, and conferences held throughout the year on technology implementation (American Occupational Therapy Association [AOTA], 2019a). However, to advance the role of occupational therapy in implementing technology, professionals must be leaders; leaders through program directing, principal investigators, becoming a clinical administrator or influencing an administrator in order to encourage, teach, inform, and facilitate the

participation of technology (Profitt et al., 2019). Additional research is needed to explore the impact of workplace culture on the use of technology in healthcare.

Funding

Cost is an additional factor that often needs to be considered when implementing technology with clients. According to a survey distributed to 161 occupational therapists, the most commonly cited barrier was the intensive process of obtaining insurance approval for the device, including the cost of the device, the availability of funding, and the time it takes to obtain authorization and the equipment (Dicianno et al., 2019). Another aspect reported by Hamblin (2017) is the issue with sustainability of cost and use when using technologies with older adults. One researcher utilized smart technology at the start of a study, providing a free service at the start of the fieldwork for one year (Hamblin, 2017). At the end of the year, clients received a letter indicating that fees would be introduced. This caused some clients to feel unsure whether they would continue to use the service or not, stating funding to be the direct barrier (Hamblin, 2017). This prevented practitioners from suggesting and implementing smart home technologies in the future with other older adults, knowing the potential for high cost from their past experiences. A similar barrier arose with other professionals, as they came across similar experiences during the assessment and installation of smart technology (Hamblin, 2017). Professionals stated that their lack of knowledge on the charging policy was a distinct barrier and some professionals indicated that they may have misadvised their clients (Hamblin, 2017).

When private pay is not possible, insurance, both private and public, commonly cover the cost for medical needs and medical equipment. In the United States, Medicare

is a commonly used public insurance that often covers medical equipment. Durable medical equipment provides a therapeutic benefit for an individual with medical needs. According to Medicare (2019), durable medical equipment is defined as medical equipment that can withstand frequent use, is needed for a medical reason, is used in the home, is typically not useful for an individual that is healthy, and lasts at least three years. When considering SHT, some devices could fit within these parameters depending on the individual client's needs and context. Smart home technology may be deemed medically necessary for some individuals and potentially be covered by insurance. Several authors suggest that funding can be established through entities such as Medicare, Medicaid, the Children's Health Insurance Program, workers compensation, TRICARE, state vocational rehabilitation centers, other federal and state programs, a variety of organizations and nonprofits that offer grants, and private insurance (Assistive Technology Industry Association, 2019; Berridge, 2018; Haymes et al., 2015).

Although the aforementioned funding sources may be available, it should be understood that SHT is not commonly covered under medical insurance; as these smart technologies are recently identified as an intervention in healthcare and not often deemed medically necessary. When attempting to utilize funding sources, push back can occur through many different sources and companies. In these instances, occupational therapists need to utilize their advocacy skills to demonstrate a medical need for the technology and the potential for improved quality of life for their client if the SHT is funded (J. Loscheider, personal communication, September 6, 2019).

In Ireland and the United Kingdom, higher technologies, such as smart technology, is funded through a variety of sources, such as charities and health,

employment, and educational services (Verdonck et al., 2011). Another possible funding avenue is homeowner insurance. Coverage would not be for the upfront cost of the device, but for protection. Many prominent home insurance companies are providing coverage for SHT in home insurance plans (American Family Insurance, 2019; Golia, 2019; Kozak, 2018; Ochalla, 2018). The insurance industry is supporting the SHT trend because of recognized benefits to the home (American Family Insurance, 2019; Golia, 2019; Kozak, 2018; Ochalla, 2018). For example, SHT may provide additional security protection and more awareness of potential water damage, among other things (American Family Insurance, 2019; Golia, 2019; Kozak, 2018; Ochalla, 2018). Some insurance companies may even provide discounts to customers who incorporate smart technology into their homes (American Family Insurance, 2019; Golia, 2019; Kozak, 2018; Ochalla, 2018).

Ethical Considerations

Ethics are a core part of a healthcare professional's identity. Occupational therapy practitioners have ethical responsibilities in relation to incorporating technology into practice. There is a need to not only keep in mind staying up to date on technology, but also the need to take specific client ethical concerns into consideration when considering and implementing new technologies, such as those placed in the home environment. Due to the dynamic nature of the profession, the evolving healthcare environment, and many new emerging technologies that are utilized in the therapy setting and home environment, there are potential ethical concerns in research, education, and practice that must be considered (AOTA, 2015). According to the Occupational Therapy Code of Ethics (AOTA, 2015), standard of conduct and principle one of *beneficence* states that

occupational therapy practitioners should "take steps (e.g., continuing education, research, supervision, training) to ensure proficiency, use careful judgement, and weigh the potential for harm when generally recognized standards do not exist in emerging technology or areas of practice" (AOTA, 2015, p.3), such as implementing smart technology.

Ethical Obligations of Occupational Therapy Practitioners

When examining the occupational therapy profession including the ethical principles and core values, it is observed that the occupational therapy profession has a duty to uphold when it comes to implementing technologies into practice (Proffitt et al., 2019). The Accreditation Council for Occupational Therapy Education (ACOTE) mandates that occupational therapy practitioners must understand, demonstrate, use, and teach the use of technology (ACOTE, 2018). Standard B.4.15 states that occupational therapy practitioners must "demonstrate knowledge of the use of technology in practice, which must include: electronic documentation systems, virtual environments, and telehealth technology" (ACOTE, 2018, p. S31). Similarly, Standard B.4.11 states that occupational therapists should "assess the need for and demonstrate the ability to design, fabricate, apply, fit, and train in assistive technologies and devices (e.g., electronic aids to daily living, seating and positioning systems) used to enhance occupational performance and foster participation and well-being" (ACOTE, 2018, p. S30). Although this is specific to assistive technologies, it relates to technologies generally, and should be considered when designing, fabricating, applying, fittings, and training colleagues and clients with smart technology devices.

Specific Ethical Considerations for Smart Home Technology

From an evolutionary perspective, the home is a natural place of comfort. Home is a place for healing where a person can let down barriers and be themselves. Due to the level of comfort and protection a home provides, caregivers and patients, tend to prefer that healthcare and healing take place in the home whenever possible (Burrows, Cotle, & Gooberman-Hill, 2018) and technologies can now assist people in their endeavor to receive healthcare at home. The increased availability of technology in the homes has spurred the need to further explore ethical considerations related to the implementation of SHT and its impact in the daily life of consumers.

An ethnographic study conducted by Burrows, Cotle, and Gooberman-Hill (2018) investigated the participant's navigation of SHT data collection and their borders of privacy and willingness to share their data. Smart home technology is likely to impede or change borders of the home with data collection potentially encroaching on privacy, blurring the lines between what is private information and public data (Burrows et al., 2018). When data is intentionally being collected by healthcare providers, Burrows et al. (2018) asserted that individuals may feel that they need to leave an impression when they know that data is being collected and are likely to not act as they would in their natural and relaxed state. Individuals participating in this study had a variety of SHT ranging from health monitoring to energy consumption monitors to home security devices. Participants in the study indicated that it mattered to them what specific data was shared. For example, data about certain health practices being shared versus data about energy consumption within the home being shared. Additionally, the personal contexts and situations the participants were experiencing affected their willingness to be open and share their data. Individuals living by themselves, who were also concerned about their

personal safety, were more willing to share their data compared to individuals living as a couple that held the belief that they were able to keep safe because they had each other. Regarding personal contexts and willingness to share data, there were two groups of individuals that were more willing to be open to implementing SHT, those familiar with SHT and individuals who had chronic health conditions that held the belief that sharing their personal data would assist in better understanding their illness and potentially help other people in the future (Burrows et al., 2018). Burrows et al. (2018) assert that frameworks need to be put in place that allow individuals to control and interact with their data. This will allow for people to maintain the boundaries, privacy, and natural comfort of the home while sharing the necessary data to ensure they are receiving the full benefits of their technology and assisting technology in becoming more effective.

Chung, Demiris, and Thompson (2016) completed the first integrative review of ethics in regards to smart home technologies and older adults. Although their research mainly applies to older adult use of SHT, it can be easily generalized in other contexts of SHT use as well. In this study, Chung et al. (2016) reviewed 16 articles published between 1990 and 2014, which used various research methodologies, although most were qualitative in nature. The following ethical areas were analyzed by the authors: informed consent, privacy, obtrusiveness, autonomy, usability, reduction in human touch, social stigma, and equal access.

Informed consent is an important factor for many aspects when introducing SHT (Chung et al., 2016), not only the research aspect, but also out of respect and consideration of the client and potential caregivers, or other individuals that may be living in the home. Informed consent includes: autonomy, doing no harm, and

beneficence. Informed consent is needed due to the nature of SHT collecting intimate, and private data and information, in order to provide services to the client. Consent is needed when considering SHT interventions, designing a SHT system, and installing SHT. In the case of older adults, more care needs to be taken in the event of cognitive decline or dementia. Caregivers need to be given all the information and facts of the risks and benefits of introducing SHT systems. It is best if informed consent is obtained in all steps of the implementation process to ensure that caregivers and clients are making the best decisions for their circumstances.

Privacy is becoming even more important when considering the introduction of new technologies into one's life and home. Smart home technology is designed to collect data and information of the client and their home in order to provide services and actions that will assist the client in a variety of ways (Burrows et al., 2018). Due to the nature of the SHT, there is a risk for privacy to be violated and for an individual to be taken advantage of (Chung et al., 2016). Because of these circumstances, privacy was found to be the core concern of older adults when considering introducing technology into their home. Participants indicated that they did not want others to know, and potentially criticize, their patterns or specific actions throughout the day. However, participants indicated that they would be willing to give up some privacy if the SHT enabled them to be more independent in their home (Chung et al., 2016).

Obtrusiveness of SHT impeding into the life and privacy of an older adult was also identified when conducting the review (Chung et al., 2016). Elements of obtrusiveness specifically included privacy, human interaction, usability, function, sustainability, physical aspects, routine, and self-concept. Participants indicated that the

installation process was obtrusive as well as specific locations of the technology, such as the bedroom. Additionally, noise and lighting of the technology was seen as an issue. Participants were also against the installation of video monitoring systems into their homes (Chung et al., 2016).

As SHT is introduced into the lives of individuals, caregivers and clients, they are likely to become accustomed to the services the technology provides. The authors considered participants autonomy and potential decrease in human touch for the client after installation of SHT. In many cases, the SHT is introduced to reduce the cost of care. Chung et al. (2016) assert that individuals, namely caregivers of older adults, may become too dependent on technology; for example, only using remote monitoring of the client. If this is the case, older adults may face an increase of technological interactions and a decrease in human interactions and human touch. This may be a detriment to the wellbeing of the older adult. Older adults indicated that they place a high value on human touch and they did not want the possibility of technology replacing those experiences. Participants imply being more accepting of a technology that initiates human contact instead of reducing it. With this in mind, before the implementation of SHT, costs, all aspects of care, and the use of SHT to assist in the care of an older adult should be contemplated in order to maintain the best quality of life for the individual (Chung et al., 2016).

Ethics are an important part of the practice of occupational therapy and should not be put to the wayside when implementing SHT interventions. Ethical considerations especially need to be made in the areas of keeping to the occupational therapy professional standards, privacy, autonomy, usability, reliability, access, social stigma,

obtrusiveness, informed consent, and potential loss of human interactions (Chung et al., 2016). The potential for blurring the lines between public and private data, as well as the client's personal comfort in their own home should also be considered (Burrows et al., 2018). The client's individual context, needs, abilities, and experiences should always be kept in mind when looking at the ethical aspects of incorporating a SHT system.

Models: Connecting Models & Technology Together

Theoretical models, frames of reference, and frameworks are an essential part of modern occupational therapy practice. These tools assist therapy practitioners with thinking about multiple factors but also guides clinical reasoning and how he or she views a client. This ensures a more client centered and holistic practice that meets the client's needs and wants. Though there are no specific models, frames of reference, or frameworks targeted specifically to occupational therapy and SHT, there are existing ones in and outside of OT practice that can guide a therapist in using SHT throughout the OT process. The Human Activity Assistive Technology (HAAT) model has been used since the mid-90s to aid occupational therapists and assistive technology practitioners in matching clients with assistive technology that meets their wants and needs (Cook & Hussey, 1995). The model emphasizes the client, in a chosen environment, and participating in an activity. It is designed to highlight the client's abilities and the selection of technology to enable the needs and wants of the individual (Cook & Polgar, 2014). As a part of the human component of the HAAT model, professionals consider client factors such as affect, cognition, motor ability, sensory ability, and experience of using technology (Cook & Polgar, 2014). Parts of the context that are assessed include: institutional, social, physical, and cultural (Cook & Polgar, 2014). The activity demands

that are considered include cognition, manipulation, and communication (Cook & Polgar, 2014). The HAAT model can be used by OTs to assess and recommend SHT that fits the needs, wants, and goals of the client. This model is suited for this because of the emphasis placed on the client and the activity. The client's abilities are extensively assessed as well as the context and activity that needs to be addressed. This directly correlates with a smart home system as the systems are customizable to each individual, perhaps even more individualized than the typically thought of assistive technology.

Another model, or design system, used by occupational therapists is universal design. The goal of universal design is to meet the needs of the broadest population. It is associated with lower cost overall and requires professionals to utilize their expertise in understanding all types of impairments and how they present across all functional tasks (Liu, 2018; Proffitt et al., 2019). Universal design should be at the forefront of the mind when constructing a smart home for a client. Many spaces that utilize SHT are constructed using universal design principles such as using SHT to track or assist occupants in precise, non-intrusive ways (Liu, 2018).

The Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), is a theory developed by information systems researchers (Liu et al., 2015; Venkatesh, Thong, & Xu, 2012). This is an expansion of the Unified Theory of Acceptance and Use of Technology (UTAUT) (Liu et al., 2015; Venkatesh et al., 2012). The UTAUT2 takes individual characteristics (age, gender, and experience) and constructs (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit) when assessing and observing the influence of these characteristics and constructs on the consumer's behavioral intention and behavioral use

of technology (Venkatesh et al., 2012). Liu et al. (2015) used the UTAUT model to examine factors that affect acceptance behavior and actual use of new technologies for rehabilitation by therapists. Using the lens of this model, they found statistical support to assert that rehabilitation professionals did not feel pressured from their co-workers to use technologies, but ultimately utilized technologies because they were useful and/or helped the clients (Liu et al., 2015). They also found that the expectation of having better patient outcomes and increased job performance of the therapist, outweighs the hurdles of learning to use new challenging technologies in practice (Liu et al., 2015). The Unified Theory of Acceptance and Use of Technology 2 is a well suited theory to utilize when examining the relationship of occupational therapy practitioners and their integration of SHT into practice because of the extensive nature of the theory as it looks into individual characteristics and constructs, and how these variables may influence the use of technology.

Summary

As evidenced in the above pages, technology is ever-changing and will continue to evolve in the future. Similarly, occupational therapy is a constant ever-changing profession and leaders in the profession during this constant ever-changing era can and should embrace the opportunities that technologies provide (Liu, 2018). As Liu (2018) states "occupational therapists cannot be leaders in this new era unless we set aside our fears and embrace the potential benefits of technologies" (p. 281). Occupational therapy practitioners can bring many diverse, creative solutions to the table when implementing technologies into client care, and can bring their expertise and understanding of the client

and human occupation into the discourse, design, and implementation of technologies (Liu, 2018).

When occupational therapy practitioners show interest and see the benefits of technology in care, they set the stage for the profession as a whole, as they are able to offer more intervention strategies and see a wide range of clients with and without disabilities. Although barriers to implementing technologies, such as access, time, funding, workplace culture, personal interest, and knowledge, can deter occupational therapy practitioners from using technologies, these same barriers can also be facilitators if the practitioner seeks out these opportunities. Occupational therapy offers a unique perspective to the smart technology industry and the profession, as they have the potential to be gatekeepers, whether working directly with clients or assisting in the process of developing technologies (Hayden, 2019). With the help of models of practice and guiding Code of Ethics (AOTA, 2015), occupational therapists already have facilitators in place to guide technology-based interventions with clients.

CHAPTER III

RESEARCH METHODOLOGY

The purpose of this study was to explore occupational therapy practitioners' utility of smart home technology in their practice. Additionally, the student researchers inquired into the factors that influence their use or non-use of this technology. Our specific sub research questions are as follows:

- What relationships exist (if any) between factors identified and reported with use of SHT?
- What relationships exist (if any) between factors identified and reported with perceived effectiveness with SHT?

The results of this project provide an understanding of occupational therapy practitioner's perspectives on smart home technology (SHT), as well as facilitators and barriers that commonly arise when using SHT. The research study followed a quantitative research design utilizing survey methodology. A quantitative internet survey was chosen because it is flexible and is the most common delivery method used to gather data on healthcare professionals (Blessing, 2016). Three key advantages to using internet surveys are (1) the sample size can be large and dispersed, (2) a large amount of data can be collected, and (3) internet survey results can be downloaded to a database, eliminating data entry and its associated errors, time, and costs for gathering data (Blessing, 2016). In addition, a descriptive research design was used, more specifically a correlational

research design. This type of design is used to inquire about relationships between at least two variables (Taylor & Kielhofner, 2017).

The framework utilized to guide this quantitative research study was the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Venkatesh, Thong, & Xu, 2012). The UTAUT2 is a theory developed by information systems researchers and considers individual characteristics and constructs, of people and technology, when evaluating the influence on the consumer's behavioral intention and behavioral use of technology (Venkatesh et al., 2012). The UTAUT2 was compatible to employ when the researchers explored the relationship of occupational therapy practitioners and their integration of SHT into practice, due to the fact that the theory's extensive nature looks at individuals and technology concurrently.

Locale of the Study

After gaining approval from the University of North Dakota's Institutional Review Board (IRB), the researchers sent out requests for survey participation virtually. Specifically, social media was chosen to accommodate for participants all around the world and for ease of access after work hours. A 30-question Qualtrics survey was distributed to participants via social media pages, which included occupational therapy-based Facebook pages that the researchers gained access to first before posting about the survey. The sites included: OT4OT; AT4OT; and the University of North Dakota Occupational Therapy Alumni page. A site that is not affiliated with Facebook that the researchers also posted the survey on was CommunOT, which is an occupational therapy blog site through the American Occupational Therapy Association (AOTA). It is a place for AOTA members to interact, engage, and share to build a professional online

community through asking questions and posing other discussion topics regarding current care provided in the field (AOTA, 2019b). By using social media sites as an outlet, this study was able to reach multiple participants of different geographic locations across the globe, with possible differing cultural backgrounds.

Population/Sampling

There was minimal inclusion criteria for the population recruited; however, the participants had to be occupational therapists or occupational therapy assistants who were interested in providing their perceptions on smart technology by taking the online survey tool. Participants did not have to be a certified Assistive Technology Practitioner (ATP), and did not have to be currently utilizing smart technology in practice. Practitioners could participate in the study regardless of gender, age, location in the world, area of practice or population most treated, level of educational degree, years of experience in the occupational therapy field, and experience with the use of technology, including smart home technologies. Recruitment was conducted through purposive and convenience sampling. Purposive sampling is done when the researcher seeks out potential participants based on specific criteria (Porteny & Watkins, 2015). This was done in this project and is represented in the fact that the researchers chose Facebook groups and CommunOT because they were specific to OT practitioners, which is a part of the inclusion criteria. Convenience sampling occurs when participants are recruited based on availability (Porteny & Watkins, 2015). This is represented in this project because the researchers reached out to potential participants via Facebook groups and CommunOT and whoever was available to participate could, if they fit the inclusion criteria.

Survey Construction

When creating the survey tool, the researchers aimed to discover how often OT practitioners were using SHT and what factors were identified as facilitators or barriers to the use of technology. The questions were based on the fieldwork experiences of the student researchers, personal educational experiences, and a thorough review of the literature. The questions were not intended to be exhaustive. When conducting the literature review the researchers found several variables that stood out to be either a barrier or support for occupational therapy practitioners in their use of SHT. These variables include knowledge (Dicianno et al., 2019; Hamblin, 2017; Jiancaro, Jaglal, & Mihailidis, 2017; Kumar et al., 2013; Proffitt et al., 2019; Verdonck et al., 2011), personal interest (Verdonck et al., 2011), workplace culture (Proffitt et al., 2019), and funding (Assistive Technology Industry Association, 2019; Berridge, 2018; Dicianno et al., 2019; Hamblin, 2017; Haymes, Storey, Maldonado, Post, & Montgomery, 2015; Verdonck et al., 2011). In addition to the variables above, the researchers assert that access and time are additional factors that support or inhibit the use of SHT by healthcare professionals. The access and time variables were not mentioned in the literature that the researchers reviewed. Because of this, the researchers made sure to add these factors to the survey tool.

Several different question designs were used including multiple choice, checklist, Likert, verbal frequency scales and open text entry. With checklist questions, the participant was able to choose more than one answer that was provided. Likert scales are of ordinal design and used to obtain participant's thoughts on the question posed with values for the answer choices (Blessing, 2016). Verbal frequency scales are similar to Likert scales but may use more answer choices and do not include values (Blessing,

2016). The open text entry options allowed participants to provide additional relevant options.

The survey tool included eleven demographic list response questions, both multiple choice and checklist. The questions ranged from age, educational degree, and country, to populations served and settings of practice. Next, three questions were designed to analyze where participants learned about SHT, how much time they have spent researching SHT, and if they have used SHT in their practice. A juxtaposed verbal frequency scale was utilized to inquire about where participants learned about SHT. Potential answers ranged from occupational therapy school, in-services, and conferences. Multiple choice questions were used to find out about how much time researching SHT was spent by the participant and if he or she used SHT in practice. If the participant answered "no" to the use of SHT in practice, they were moved to the next block of questions, in contrast, if they answered "yes", there were several additional questions in the block relating to the participant using SHT in practice. A verbal frequency scale was used to find out how often the participant used SHT in practice and a multiple choice question asked how many years he or she had been using the technology in practice. Likert scales were used to ask about the participants comfort with using SHT and perceived effectiveness with using SHT. Additionally, we utilized checklist questions to inquire about funding sources the participant used to access SHT for his or her clients, as well as supports the participant had for utilizing SHT with clients. In the next block of questions, we wanted to learn about the participant's interest in SHT and more specific variables of barriers and supports. The researchers utilized a verbal frequency scale to measure participants' interest in SHT. Verbal frequency scales were also used to measure

interest in researching SHT as well as the participants' perceived knowledge about SHT. Next, multiple choice questions were used to ask about additional factors including: time the participants had for researching SHT; how much access to SHT the respondent had; if the respondent's employer provided funding for the respondent to use SHT with clients; and if the respondent had any additional funding sources. Lastly, a verbal frequency scale was used to inquire about how much the respondent's workplace supported the use of SHT.

Instrumentation and Data Collection

The 30-question survey tool was built into Qualtrics survey software (see Appendix A), which was chosen based on its confidentiality, dependability, and ease of access to the researchers. When building the survey, the researchers examined the survey through many lenses. The two student researchers, the research advisor, and an associate professor in population health, who specializes in working with IBM Statistical Package for the Social Sciences (SPSS), all analyzed and reviewed the survey for further edits before submitting to the Institutional Review Board. Once approval was received from the University of North Dakota's Institutional Review Board (see Appendix B), the surveys were made available on social media sites via link connecting to the survey tool in Qualtrics. An informed consent document (see Appendix C) immediately preceded the beginning of the Qualtrics survey. Surveys were recorded and stored in the University of North Dakota's Qualtrics Survey Software. This data was stored in a password protected, institutional folder where only the researchers and the researcher's advisor could access the data to protect the confidentiality of the participants. The survey remained open for five weeks, and the researchers were available to participants via email, phone, and social

media messaging if the participants had any questions, concerns, or problems based on taking the Qualtrics survey.

Tools for Data Analysis

After the closure of the survey, the data was downloaded from Qualtrics into an Excel file, which was then converted and uploaded into a statistical software package. All of the statistical tests were run with SPSS, version 26 which is the most recent version available. There were a variety of tests run when completing data analysis, including descriptive frequencies and Spearman *rho* correlation coefficients.

Data that was classified as demographic information was analyzed by running descriptive statistics to identify the frequency distribution and percentage values. Descriptive frequencies were chosen to analyze demographic data to show distributions for the specified variables (Cronk, 2017). Descriptive frequencies were also ran on the variables of perceived *effectiveness* when using smart home technology, *education* (amount of education and amount of research) gained on smart home technology, *supports* (e.g. through employers, funding, and workplace atmosphere) for using smart home technology, *personal use* (e.g. how often is he/she is utilizing in practice, *comfort* with implementing, level of personal *interest* and *knowledge* of smart home technology in practice, and *availability* (access and time available) to utilize smart home technology and resources. The output includes the number of occurrences, percentages, valid percentages, and cumulative percentages (Cronk, 2017).

Running descriptive frequencies and percentage values helped the researchers to draw conclusions based on describing the numbers or percentages of cases in the sample based on the variables being examined. The descriptive statistics provided information

from the data regarding the number of individuals responding in relation to the specified variable (*n*), range of values, minimum and maximum values, mean value, and standard deviations. All of these descriptives were reviewed to help the researchers get a full understanding of the population sample. The valid percentages and the cumulative percentages comprise only the data that are not designated as missing. Valid percentages give the percentage of records (without including records with missing data) for each value, whereas cumulative percentages indicate the percentage of records with a score equal to or smaller than the current value (Cronk, 2017). Thus, the last value is always 100%. The frequencies command is useful for describing samples where the mean is not useful (Cronk, 2017). It is also useful as a method for getting a better understanding of the data, and it provides more information than just a mean and standard deviation (Cronk, 2017). Along with the above reasons for choosing descriptive frequencies, it also helps to determine skew and identifying outliers (Cronk, 2017). Thus the reason for choosing descriptive frequencies.

When the researchers analyzed their initial thoughts at the beginning of this project, there were several areas that the researchers thought would stand out in relation to barriers and facilitators when utilizing SHT. These areas were: perceived effectiveness when using SHT, where SHT education was obtained, personal use of SHT in practice, support to use SHT, access to SHT, and time to implement SHT in practice. As mentioned previously, the researchers worked with an associate professor who specializes in statistics and works as a consultant with the occupational therapy department. The professor assisted in narrowing the 30 questions in the survey tool into variables that were formed from the areas mentioned above. The variables will be

referred to as *availability (access and time), support, education, interest, knowledge, comfort, effectiveness, funding, and use* from now on... The survey questions that formed each variable are described below. In the results of the data analysis (chapter 4), the relationships between these variables is described further.

Availability (Access and Time)

- Question 26: "Do you feel that you have time to implement smart home technology with clients?"
- Question 27: "Do you have access to smart home technology products and resources?"

Support

Support is divided into three different support variables. If a respondent checked "no supports" (Q21), and gave no rating (Q30), they received a 0. If they had supports in place, but no rating, they got the number of supports as their score. If they had a rating but did not list supports, they got their rating as a score. Otherwise, the score was the multiple of the number of supports and their rating of them (ranging from 0 to 12). The second support variable was put into a support level, meaning the support variable was categorized into 4 levels: 0, 1, 2, 3+. Finally, the third support variable was whether they simply stated "yes" or "no", indicating they do have some level of support.

- Question 21: "Identify supports you have encountered regarding the use of smart home technology."
- Question 30: "Rate the level of support within your place of work in utilizing smart home technology."

Education

- Question 12: “Identify the amount of education you have gained about smart home technology through the following means.”

Interest

- Question 22: “Rate the level of personal interest in using smart home technology.”
- Question 24: “Rate your interest in researching more about smart home technology use.”

Knowledge

- Question 25: “Rate your knowledge on smart home technology.”

Comfort

- Question 18: “Rate your comfort with using smart home technology.”

Effectiveness

- Question 19: “Rate your effectiveness in utilizing smart home technology.”

Funding

- Question 20: “What sources of funding have you utilized to access smart home technology for clients?”
- Question 28: “Does your current employer provide funding for trial use of smart home technology with clients?”
- Question 29: “Do you have access to other funding sources (outside of employer support) for implementing smart home technology (i.e. grants, insurance)?”

Use

Use was divided into three variables. The first being if a participant answered "yes" to Q15 (uses SHT) then the score was the sum of their frequency of use (Q16) and the number of years they have used it (Q17). Then, Q17 was subtracted by 1 to only add to the Q16 score if they had been using more than 5 years. The second and third use variables were divided into use of SHT levels: 0,1, 2, and 3+, and a "yes" or "no" answer based on Q15.

- Question 15: "Do you incorporate smart home technology into practice?"
- Question 16: "How often do you use smart home technology in your OT practice?"
- Question 17: "How many years have you been utilizing smart home technology in your OT practice?"

The researchers wanted to examine the relationships between perceived effectiveness of the occupational therapy practitioner with utilizing SHT, education received on SHT, support to use SHT, the use of SHT in practice, and availability to SHT and resources by utilizing inferential statistical tests. The Spearman *rho* correlation coefficient was chosen to determine if any relationship was present between the above mentioned variables, and whether the relationship presented itself as a facilitator or barrier to utilizing smart home technology in practice. The Spearman *rho* correlation coefficient (sometimes called Spearman *rho*) determines the strength of the relationship between two variables (Cronk, 2017). A correlation coefficient will be between -1.0 and +1.0, with coefficients close to 0.0 representing a weak relationship and coefficients close 1.0 or -1.0 representing a strong relationship (Cronk, 2017). A significant correlation indicates a reliable

relationship, but not necessarily a strong correlation (Cronk, 2017). Generally, correlations with an absolute value greater than 0.7 are considered strong, whereas absolute values less than 0.3 are considered weak and correlations with an absolute value between 0.3 and 0.7 are considered moderate (Cronk, 2017).

Reliability and Validity

In order to answer the gaps in the literature on this topic, it was necessary for the researchers to create an innovative survey tool, thus the tool used in this project was an unstandardized questionnaire. Unstandardized questionnaires have not been used or tested previously and therefore do not have data that support or refute their use (Taylor & Kielhofner, 2017). Hence, it is not possible to establish true reliability and validity of the tool that was developed. Although the researcher's tool has been created to answer the identified specific research questions and the tools reliability and validity is not able to be measured, the researchers have created a quality survey to accurately measure data. This was done by minimizing bias in the design of the survey. It is important to avoid bias in a questionnaire so the most accurate data can be collected from the participants (Choi & Pak, 2005). Bias can occur when there is miscommunication between what the investigators are asking and what the participants are perceiving what they are being asked (Choi & Pak, 2005). Bias as a whole can occur because of the design of individual questions as well as the design of the entire survey (Choi & Pak, 2005). The researchers conducted many information sessions with not only each other, but with their advisor and consulting associate professor to minimize biases.

The researchers minimized bias in the design of the survey by using multiple methods. Choi and Pak (2005) identified numerous types of bias. With the survey design,

it was possible to avoid bias in the areas of wording, missing or inadequate data for intended purpose, inconsistency, formatting problems, and questionnaire length. Wording bias was averted by refraining from double-barreled and ambiguous questions, rather the researchers used clear and concise wording. The bias of missing or inadequate data for intended purpose was circumvented by ensuring sensitive measures. This was done by giving multiple categories to choose from to avoid type II errors, which is not reporting a relationship between two variables where there is one (Taylor & Kielhofner, 2017). In addition, the researchers made sure to use several intervals ensuring all potential choices were represented and did not overlap any intervals, contributing to the accuracy of each category. Inconsistency bias was deflected by remaining consistent with the types of scales and wording present in the questions.

Formatting problem bias using vertical response formats for listing type questions was used to avoid responder confusion due to the fact that horizontal response formats for listing questions may cause confusion with spacing and has a higher likelihood of incorrect answers being selected (Choi & Pak, 2005). In addition, right alignment questions were utilized by placing the response choice before the response word. This makes it easier for the respondent to read more easily (Choi & Pak, 2005). The bias of questionnaire length was eluded by limiting the amount of yes and no questions and keeping the survey short. This also assisted in avoiding response fatigue by keeping the survey completion time to approximately 15 minutes. Surveys should not be longer than 20 minutes (Choi & Pak, 2005). In addition, when it was appropriate for the respondent to skip questions, automatic question skipping was utilized within the software to avoid confusion and unintentional skipped questions.

Summary

The steps described above outlined the process that was used through the course of this study to ensure that quality data was produced. Each member of this research team took significant time to process through the details of this study from start to finish to ensure that the resulting data could be used to explore and expand the role of occupational therapy practitioners with implementing smart technology into their practice now and in the future. The following chapter outlines the findings from the research.

CHAPTER IV

PRESENTATION & ANALYSIS OF DATA

Much has been published regarding the usefulness of smart home technology for clients, as well as pieces encouraging healthcare professionals to use SHT. In contrast, there is limited literature that examines the perspectives of occupational therapy practitioners (OTPs) use of SHT. The researchers recognize that there is a need for SHT to be utilized in OT practice, but the researchers wanted to understand further the utilization of SHT by OTPs. This quantitative descriptive study primarily sought to survey participant's perceptions of SHT, and to determine facilitators and barriers to the implementation of SHT into practice. Results are presented through descriptive frequencies and correlations. Findings are discussed in more detail in the discussion section (Chapter V).

At the commencement of this study, the researchers hypothesized that supports and barriers impacting use of SHT, would be identified by OTPs. The overarching research question is "what is the utility of smart home technology within occupational therapy practice?". Two additional sub-questions were developed which are as follows:

- What relationships exist (if any) between factors identified and reported with use of SHT?
- What relationships exist (if any) between factors identified and reported with perceived effectiveness with SHT?

Descriptive Demographics

Descriptive frequencies were run to get a more thorough explanation of the demographics of the data set. Participation of both occupational therapists (OT) and occupational therapy assistants (OTA) were both permitted in this research study. Seventy-five people completed the survey. Participants included five males, 68 females, and one participant preferred not to answer. Participants included 63 OTs and 2 OTAs. The geographical area of the practitioners were split into two categories, rural (*n*=29) and metropolitan (*n*=41). Highest level of education achieved by participants included bachelors degrees (*n*=24), masters degrees (*n*=31), research doctorate degrees such as Ph.D. or Ed.D. (*n*=4), and occupational therapy clinical doctorate degrees (*n*=9). Age of participants included, 20-30 (*n*=20), 31-40 (*n*=15), 41-50 (*n*=19), 51-60 (*n*=12), and 61+ (*n*=6). One participant preferred not to answer the question. Years of practice experience included, 1-4 years (*n*=18), 5-10 years (*n*=9), 11-15 years (*n*=9), 16-20 years (*n*=7), 21-25 years (*n*=12), and 26+ years (*n*=14).

The age of populations served by the practitioners varied, pediatrics (*n*=26), adolescents (*n*=19), adults (*n*=43), and older adults (*n*=47). Practice settings identified by participants include: inpatient/acute (*n*=16), outpatient (*n*=23), skilled nursing facility/transitional care unit (*n*=8), school system (*n*=13), home health/in-home care (*n*=25), and other (*n*=17). The practitioner's identified the focus of their practice using the American Occupational Therapy Association's (AOTA's) practice areas. Identified practice areas include: children/youth (*n*=22), health and wellness (*n*=15), mental health (*n*=8), productive aging (*n*=18), rehabilitation and disability (*n*=47), and work and industry (*n*=5). Thirty-eight participants identified as being a certified Assistive

Technology Practitioner (ATP). Please see Table 1 below for a visual summary of the demographics.

Table 1

Demographics

Variable	N	Percentage
Gender		
Male	5	6.7%
Female	68	90.7%
Age		
20-30 years old	20	26.7%
31-40 years old	15	20.0%
41-50 years old	19	25.3%
51-60 years old	6	17.3%
61+ years old	1	8.0%
Prefer not to answer	1	1.3%
Type of Practitioner		
Occupational Therapist	64	85.3%
Occupational Therapy Assistant	2	2.7%
Assistive Technology Practitioners	3	4%
Live United States	46	61.3%
Living Internationally	18	38.7%
Serve Rural Populations	29	38.7%
Serve Metropolitan Populations	41	54.7%
Years of Practice		
1-4 years	18	24%
5-10 years	9	12%
11-15 years	9	12%
16-20 years	7	9.3%
21-25 years	12	16%

25+ years	14	18.7%
Level of Education		
Bachelors degree	24	32%
Masters Degree	31	41.3%
Research Doctorate	4	5.3%
Clinical Doctorate	9	12%
Populations Served		
Pediatrics	26	34.7%
Adolescence	19	25.3%
Adults	43	57.3%
Older Adults	47	62.7%
Setting of Practice		
Inpatient/Acute	16	21.3%
Outpatient	23	30.7%
Skilled Nursing Facility	8	10.7%
School System	13	17.3%
Home Health	25	33.3%
Other	17	22.7%
Area of Practice		
Children/Youth	22	29.3%
Health and Wellness	15	20%
Mental Health	8	10.7%
Productive Aging	18	24%
Rehabilitation and Disability	47	62.7%
Work and Industry	5	6.7%

Descriptive Statistics

Descriptive frequencies were run on all questions presented in the survey. The researchers identified select questions to present below. The output includes the number of occurrences (frequencies), percent's, and valid percent's. The valid percentages and the cumulative percentages comprise only the data that are not designated as missing. Please see Chapter Three: Methodology, for a complete description of what these values mean, and how to interpret them in relation to the data. Presentation of the data set below is explained using frequencies (*n*) and valid percentages, when percentages are presented.

Participants were asked to identify the amount of education they have gained about smart home technology *while in OT school, through independent research/study, through informal in-services (such as lunch and learns, etc.), general continuing educational conferences, continuing educational conferences that focused specifically on smart home technology*, and *other*, which was provided for alternate responses that were not listed by the researchers. Participants were asked to rate the amount of education they had received on a 5-point Likert scale (1=no education; 5=significant education). Sixty-seven participants responded to the question inquiring about the amount of education gained while in occupational therapy school. Fifty-two percent received none, 30% received little education, 10% received some education, 5% received a lot of education, while 3% received significant education on SHT while in OT school.

The same 5-point Likert scale was used to identify education received on SHT through independent research and study opportunities, 64 participants responded with 22% indicating they received no education, 23% received little education, 25% received some education, 25% received a lot of knowledge, and only 5% responded receiving

significant education on SHT through their own independent research and study opportunities.

Occupational therapy practitioners gain education on SHT through informal in-services, such as lunch and learns. Of the participants (*n*=66) that answered this question, 41% received no education, 33% received little education, 23% received some education, 2% received a lot of education, and 2% received significant education.

General and specialty continuing education conferences provide educational opportunities for occupational therapy practitioners. General conferences typically provide information covering several topic areas, whereas specialty conferences provide in-depth education focusing on a specific topic. When inquiring about general continuing education conferences (*n*=66), 29% received no education, 36% received little education, 27% received some education, 6% received a lot of education, and only 2% received significant education on SHT through general continuing educational conferences.

Specialty continuing education conferences may cover more specific topics which could include smart home technology. Of the 64 participants, 44% received no education, 28% received little education, 17% received some education, 11% received a lot of education and zero participants reported receiving a significant amount of education on SHT through specialty continuing education conferences. See Table 2 and Figure 1 for visual representation of the data.

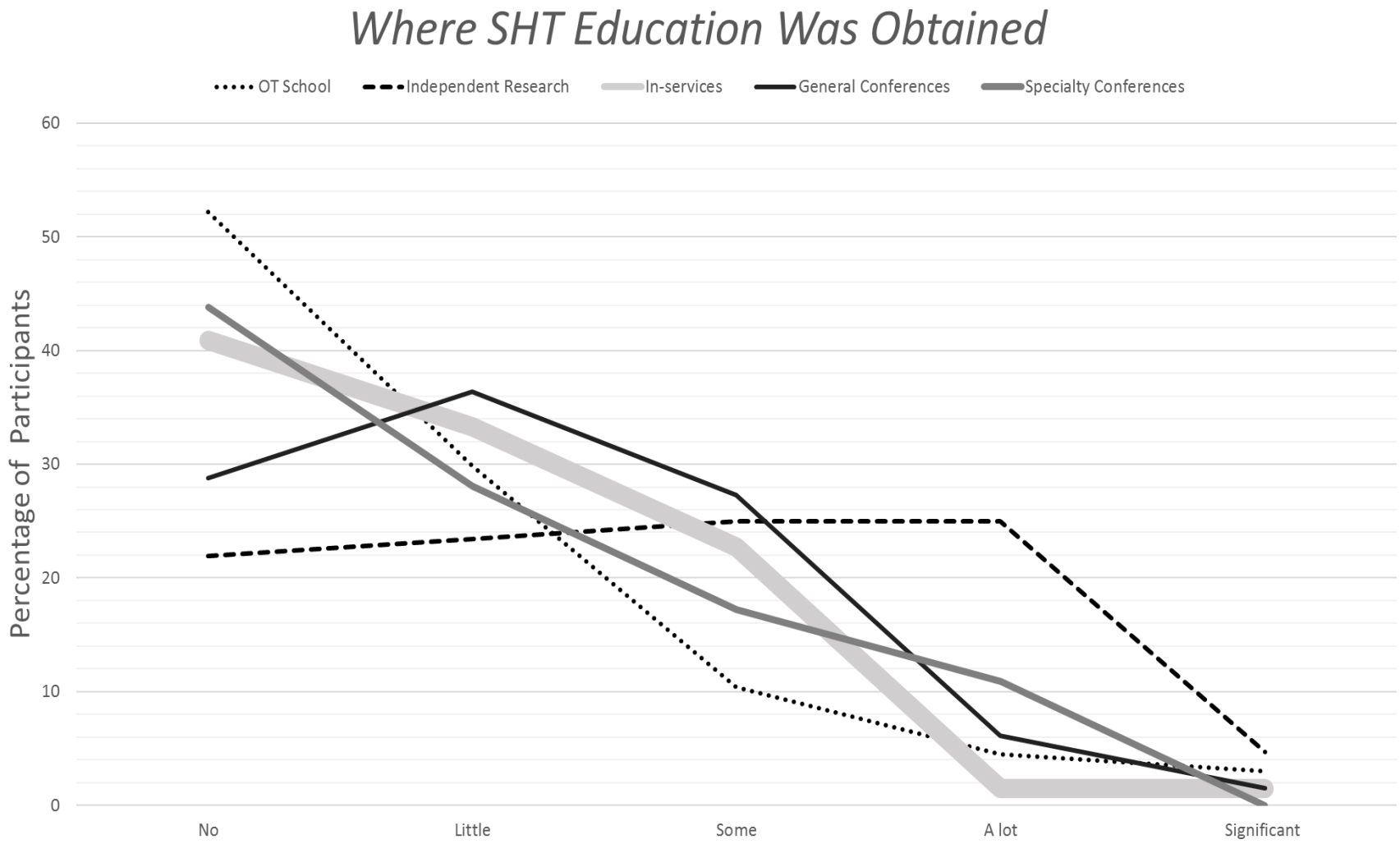
Table 2

Amount of Education Received on SHT

Variable	N	Percentage
While in OT school		
No education	35	52.2%
Little education	20	29.9%
Some education	7	10.4%
A lot education	3	4.5%
Significant education	2	3%
Independent research/study		
No education	14	21.9%
Little education	15	23.4%
Some education	16	25%
A lot education	16	25%
Significant education	3	4.7%
Informal in-service		
No education	27	40.9%
Little education	22	33.3%
Some education	15	22.7%
A lot education	1	1.5%
Significant education	1	1.5%
General continuing education Conference		
No education	28	43.8%
Little education	18	28.1%
Some education	11	17.2%
A lot education	7	10.9%
Significant education	0	0%
Other		
No education	13	61.9%
Little education	3	14.3%
Some education	2	9.5%
A lot education	2	9.5%

Figure 1

Where SHT Education was Obtained



Participants were asked to identify how much time they had spent researching smart home technology, either at work or at home, within the last five years, using a 5-point Likert scale (1=none; 5=10+ hours/week). Of the participants that answered (*n*=65), 15% had completed no research, 59% completed less than 1 hour/week, 20% completed 1-5 hours/week, 2% completed 5-10 hours/week, and 5% completed 10+ hours of research per week, within the last 5 years.

Similarly, participants were asked to identify how much time they had spent researching smart home technology, either at work or at home, within the last six months. The answer selections were based on the same 5-point Likert scale mentioned previously. Of the participants that answered (*n*=65), 18% had completed no research, 54% completed less than 1 hour/week, 25% completed 1-5 hours/week, 3% completed 5-10 hours/week, and zero participants had completed 10+ hours of research per week on SHT in the last six months. See Table 3 and Figure 2 for visual representation of the data

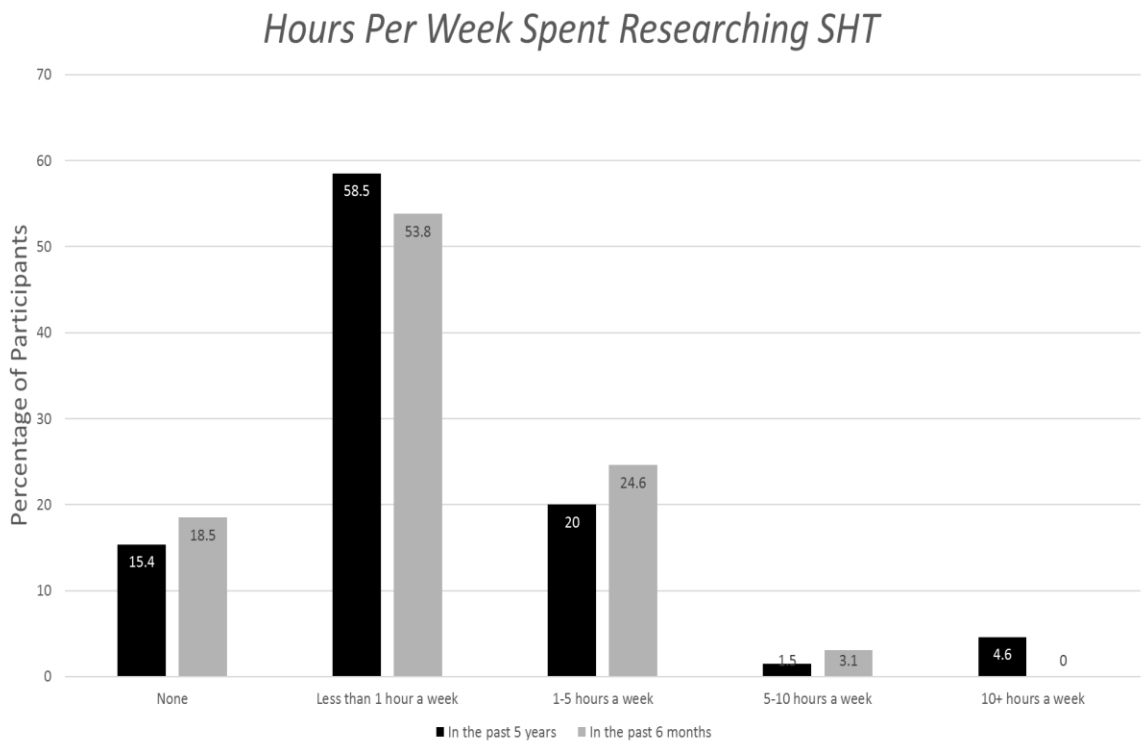
Table 3

Time Spent Researching SHT

Variable	N	Percentage
Time spent researching SHT in the last 5 years		
None	10	15.4%
Less than 1hr/wk	38	58.5%
1-5hrs/wk	13	20%
6-10hrs/wk	1	1.5%
10+hrs/wk	1	4.6%
Time spent researching SHT in the last 6 months		
None	12	18.5%
Less than 1hr/wk	35	53.8%
1-5hrs/wk	16	24.6%
6-10hrs/wk	2	3.1%
10+hrs/wk	0	0%

Figure 2

Hours per Week Spent Researching SHT



Participants were asked whether they incorporate smart home technology into their practice. Of the responding participants (*n*=75), 63% reported not using SHT in practice whereas 37% reported using SHT in practice. See Table 4 and Figure 3 below for visual representation of the data.

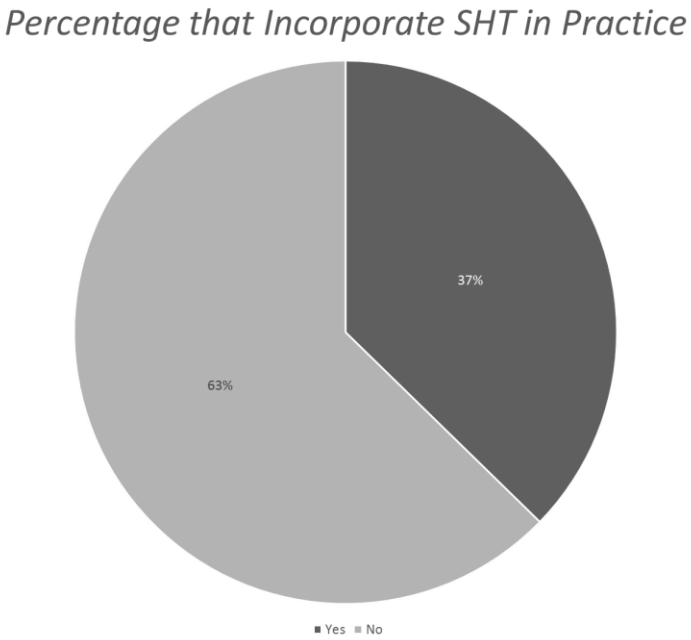
Table 4

Incorporation of SHT into Practice

Variable	N	Percentage
Incorporation of SHT into practice		
No	47	62.7%
Yes	28	37.3%

Figure 3

Percentage that Incorporate SHT into Practice



Survey participants who indicated using smart home technology in practice were asked to rate their comfort with using smart home technology, on a 5-point Likert scale (1=not at all comfortable using; 5=extremely comfortable using).Of the participants that answered (*n*=27), no participants reported feeling not at all comfortable, 7% feel slightly comfortable, 33% somewhat comfortable, 56% moderately comfortable, and only 4% feel extremely comfortable with using SHT.

Survey participants who use smart home technology were also asked to rate their perceived effectiveness in utilizing smart home technology on a 5-point Likert Scale (1=not at all effective; 5=extremely effective). Of the participants that answered (*n*=27), no participants reported feeling not at all effective, 15% feel slightly effective, 33% somewhat effective, 45% moderately effective and only 7% feel extremely effective when using SHT. See Table 5 and Figure 4 below for visual representation of the data.

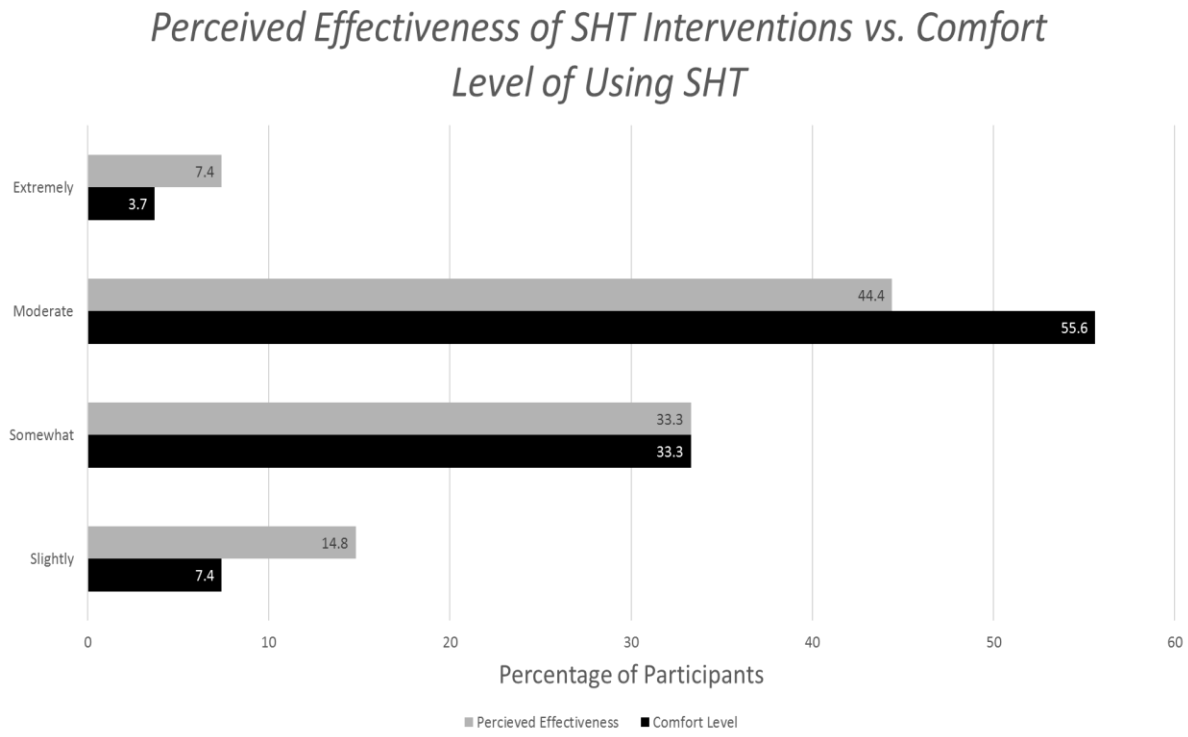
Table 5

Comfort and Perceived Effectiveness with Using SHT

Variable	N	Percentage
Comfort		
Slightly	2	7.4%
Somewhat	9	33.3%
Moderate	15	55.6%
Extremely	1	3.7%
Effectiveness		
Slightly	4	14.8%
Somewhat	9	33.3%
Moderate	12	44.4%
Extremely	2	7.4%

Figure 4

Perceived Effectiveness & Comfort Using SHT



Participants that indicated they use smart home technology in their practice were asked to identify supports they have encountered with using smart home technology. Of the participants who responded (*n*=27), 16 identified co-worker(s), 8 identified family, 7

identified professional organizations, 6 identified special interest groups/communities of practice, 6 identified friends, 4 identified mentor(s), and another 4 identifying "other" as a source of support for utilizing SHT. The four participants (5%) who listed "other" supports, identified no supports, suppliers, local building designers, and companies providing the equipment (reps). See Table 6 and Figure 5 below for visual representation of the data.

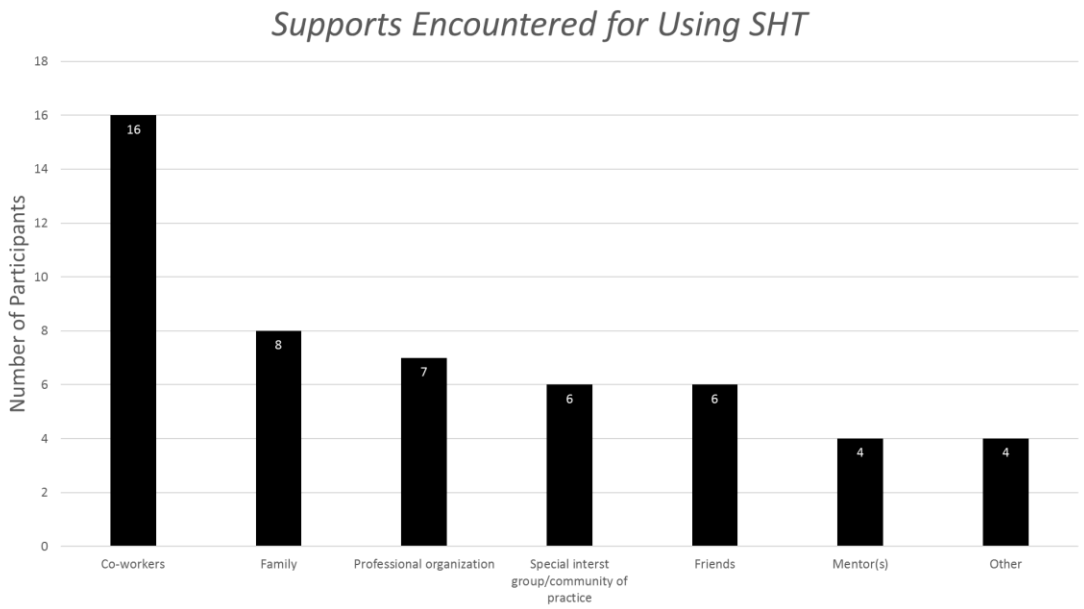
Table 6

Supports for Using SHT

Variable	N
Co-workers	16
Mentor(s)	4
Professional organization	7
Special interest group/community of practice	6
Friends	6
Family	8
Other	4

Figure 5

Supports for Using SHT



Participants were asked to rate their level of personal interest using a 5-point Likert scale (1=not at all interested; 5=extremely interested), in using smart home technology. Of the participants that chose to answer the question (*n*=61), only one participant (2%) stated being not at all interested, 20% slightly interested, 34% somewhat interested, 21% moderately interested, 23% extremely interested in using smart home technology. See Table 7 and Figure 6 below for visual representation of the data.

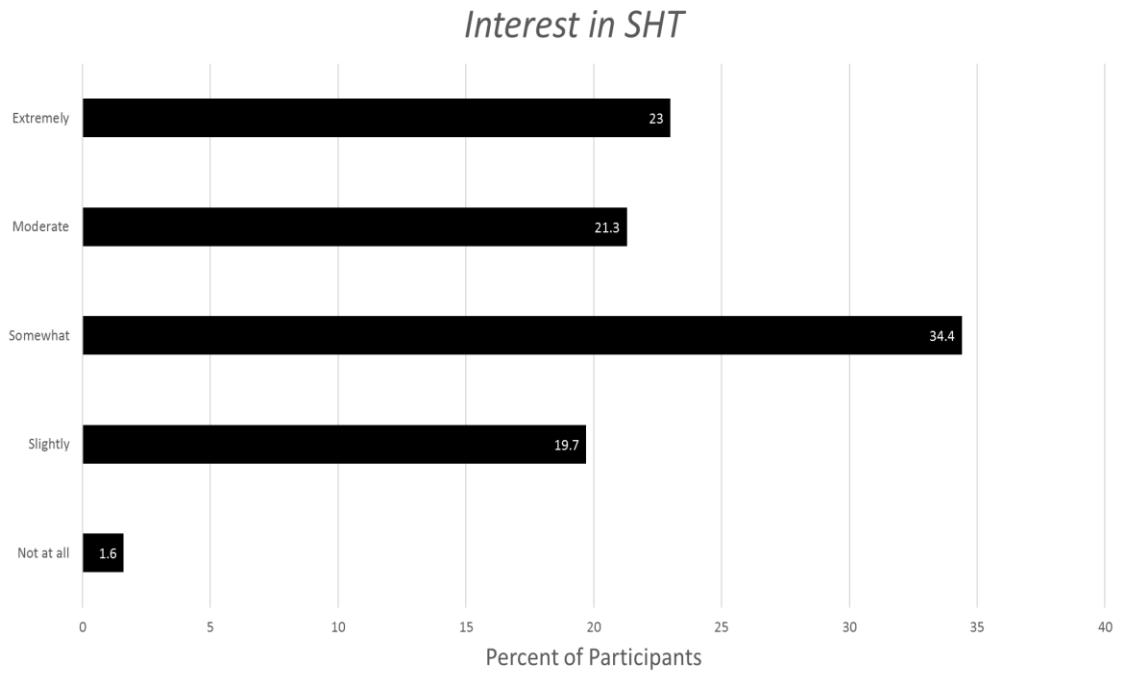
Table 7

Level of Interest in Using SHT

Variable	N	Percentage
Level of interest in using SHT		
Not at all	1	1.6%
Slightly	12	19.7%
Somewhat	21	34.4%
Moderate	13	21.3%
Extremely	14	23%

Figure 6

Interest in SHT



Participants were asked to rate their perceived level of knowledge on smart home technology, using a 5-point Likert scale (1=no knowledge; 5=extreme knowledge). Of the participants that chose to answer the question (*n*=61), 12% reported no knowledge, 28% slight knowledge, 33% some knowledge, 26% moderate knowledge, and only one individual (2%) reported extreme knowledge on smart home technology. See Table 8 and Figure 7 below for visual representation of the data.

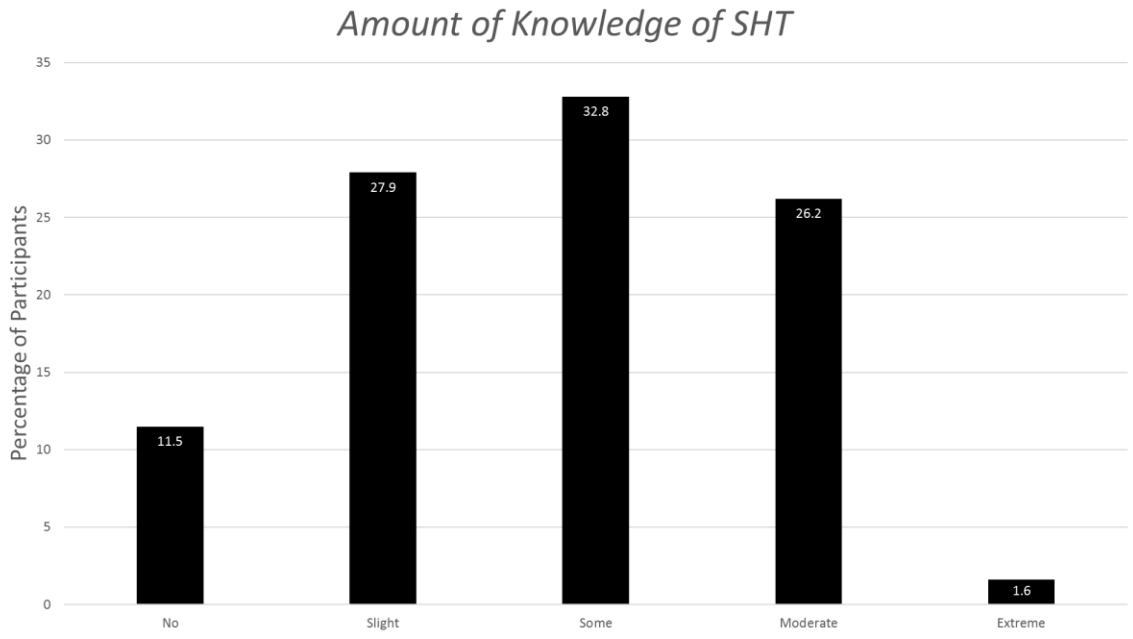
Table 8

Perceived Knowledge of SHT

Variable	N	Percentage
Knowledge of SHT		
No knowledge	7	11.5%
Slight knowledge	17	27.9%
Some knowledge	20	32.8%
Moderate knowledge	16	26.2%
Extreme knowledge	1	1.6%

Figure 7

Perceived Knowledge of SHT



Participants were asked whether they have time to implement smart home technology with clients. Of the participants who answered (*n*=75), 57% reported not having time whereas 43% reported having time to implement SHT into practice. In regards to access, participants were asked if they have access to smart home technology products and resources. Of the participants who answered (*n*=61), 36% reported having access, 36% reported not having access and 28% identified being unsure if they had access to SHT products and resources. See Table 9 and Figure 8 below for visual representation of the data.

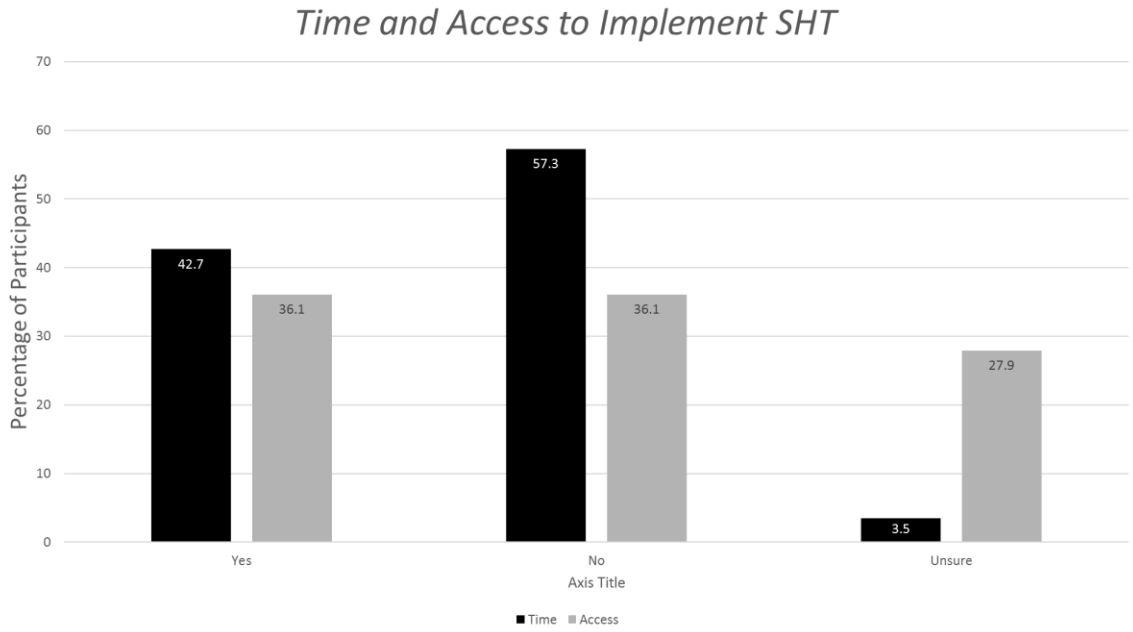
Table 9

Time and Access to SHT

Variable	N	Percentage
Time to implement SHT with clients		
Yes	32	42.7%
No	43	57.3%
Access to SHT products and resources		
Yes	22	29.3%
No	22	29.3%
Unsure	17	22.7%

Figure 8

Availability to Implement SHT



The researchers inquired about availability of funding by asking participants about employer provided funding for trial use of smart home technology and if they have access to other funding sources outside of employer support to implement SHT. Of the 61 participants who answered, only 5% identified having employer provided funding whereas 85% identified not having funding available from their employer to implement SHT into practice. Interestingly, 10% identified being unsure if their employer provided funding for implementation of SHT.

Participants were also asked if they have access to other funding sources outside of employer support, such as grants and insurance to support implementation of smart home technology. Of the participants who answered (*n*=60), 20% reported having access to other funding sources whereas 52% reported not having other funding sources available to implement SHT into practice. Another 28% identified being unsure if they

have access to other funding sources outside of their current employer for implementation of SHT. See Table 10 and Figure 9 below for visual representation of the data.

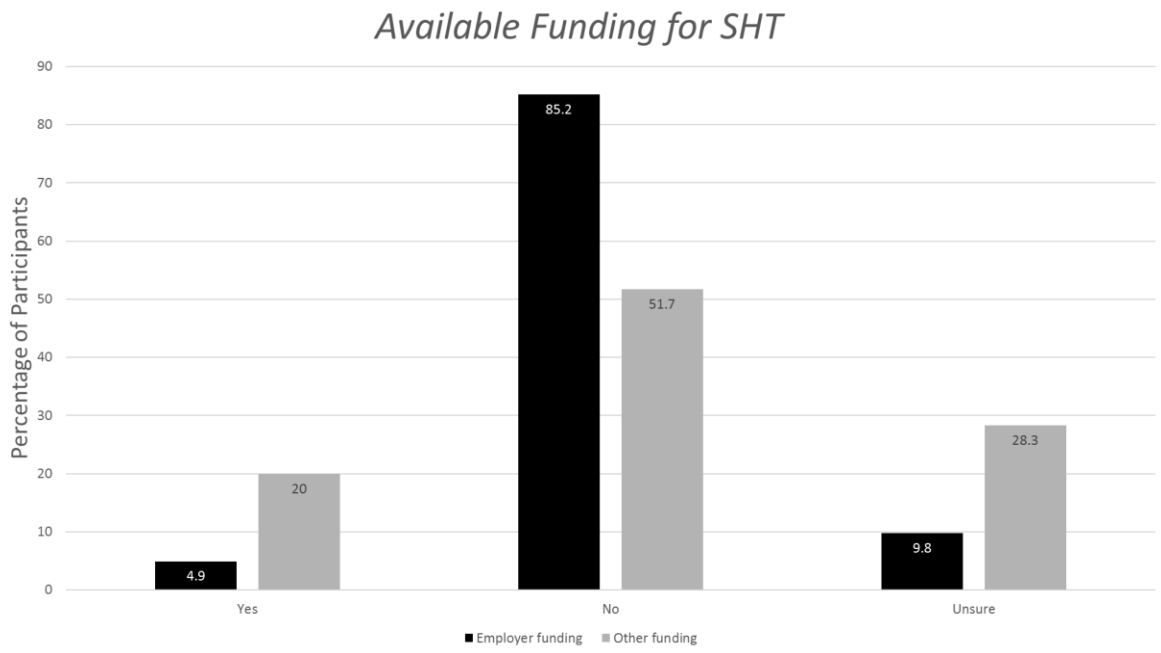
Table 10

Employer Funding for SHT and Access to Other Funding Sources for SHT

Variable	N	Percentage
Employer provides funding for SHT		
Yes	3	4.9%
No	52	85.2%
Unsure	6	9.8%
Access to other funding sources for SHT		
Yes	12	20%
No	31	51.7%
Unsure	17	28.3%

Figure 9

Available Funding for SHT



Inferential Statistics

A Spearman correlation coefficient (Spearman *rho*) was used to determine the strength of the relationship between the variables. It is a nonparametric procedure, and can be used in more situations than the Pearson correlation coefficient. The output consists of a correlation matrix. The three rows represented in each cell contain the correlation, the significance level, and the *N* (Cronk, 2017). The Spearman *rho* ranges from -1.0 to +1.0. If a correlation is significant at less than the .05 level, a single asterisk (*) will appear next to the correlation. If it is significant at the .01 level or lower, a double asterisk (**) will appear next to the correlation. A significant correlation indicates a reliable relationship, but not necessarily a strong correlation. Coefficients close to 0.0 represent a weak relationship. Coefficients close to 1.0 or -1.0 represent a strong relationship. Positive correlations indicate that as one variable gets larger, the other variable gets smaller (Cronk, 2017). Generally, correlations greater than 0.7 are considered strong, and correlations less than 0.3 are considered weak. Correlations between 0.3 and 0.7 are considered moderate. For the purpose of the output listed below, degrees of freedom is *N* - 2.

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's degree of availability of using smart home technology (time and access) and degree of support (slight, some, moderate, full) the participants had in implementing SHT. A moderate positive correlation was found (*rho* (73) = .607, *p* = .000), indicating a significant relationship between the two variables. Participants who have a higher degree of support for utilizing SHT tend to have more availability for using SHT in practice. See Table 11 below for visual representation of the data.

Table 11

Correlation between Availability and Degree of Support

Correlation Coefficient	.607
Significance (2 tailed)	.000
N	73

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's degree of availability of using smart home technology (time and access) and the level of interest in utilizing SHT in practice. A moderate positive correlation was found (*rho* (59) = .533, p = .000), indicating a significant relationship between the two variables. Participants who have more availability to SHT tend to be more interested in learning and utilizing SHT in practice. See Table 12 below for visual representation of the data.

Table 12

Correlation between Availability and Level of Interest

Correlation Coefficient	.533
Significance (2 tailed)	.000
N	59

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's degree of availability of using smart home technology (time and access) and whether they currently receive funding (simple yes/no) for utilizing SHT in practice. A moderate positive correlation was found (*rho* (73) = .354, p =.001), indicating a significant relationship between the two variables. Participants who currently receive funding for implementing SHT into their practice tend to have better availability to SHT. See Table 13 below for visual representation of the data.

Table 13

Correlation between Availability and Funding

Correlation Coefficient	.354
Significance (2 tailed)	.001
N	73

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's degree of support (slight, some, moderate, full) with implementing smart home technology into practice and level of interest of utilizing SHT in practice. A moderate positive correlation was found (*rho* (59) = .550, $p = 0.000$), indicating a significant relationship between the two variables. Participants with more interest in SHT tend to have greater support when utilizing SHT in practice (full support vs. slight). See Table 14 below for visual representation of the data.

Table 14

Correlation between Degree of Support and Level of Interest

Correlation Coefficient	.550
Significance (2 tailed)	.000
N	59

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's degree of support (slight, some, moderate, full) with implementing smart home technology into practice and whether they currently receive funding (a simple yes/no answer) for utilizing SHT in practice. A moderate positive correlation was found (*rho* (73) = .614, $p = 0.000$), indicating a significant relationship between the two variables. Participants who currently receive funding for implementing SHT into their practice tend to have greater support when utilizing SHT in practice (full support vs. slight). See Table 15 below for visual representation of the data.

Table 15

Correlation between Degree of Support and Funding

Correlation Coefficient	.614
Significance (2 tailed)	.000
N	73

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's degree of support (slight, some, moderate, full) with implementing smart home technology into practice and whether they were currently using SHT (yes/no). A moderate positive correlation was found (*rho* (73) = .546, *p* = .000), indicating a significant relationship between the two variables. Participants who are using SHT tend to have greater support when utilizing SHT in practice (full support vs. slight). See Table 16 below for visual representation of the data.

Table 16

Correlation between Degree of Support and Use

Correlation Coefficient	.546
Significance (2 tailed)	.000
N	73

Spearman *rho* correlation coefficient was calculated for the relationship between participant's sources of support (co-workers, mentors, professional organizations, special interest groups/community of practice, friends, family) and whether they were currently using SHT (yes/no). A moderate positive correlation was found (*rho* (73) = .541, *p* = .000), indicating a significant relationship between the two variables. Participants who are using SHT tend to have greater sources of support when utilizing SHT in practice. See Table 17 below for visual representation of the data.

Table 17

Correlation between Sources of Support and Use

Correlation Coefficient	.541
Significance (2 tailed)	.000
N	73

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's amount of education (no education, little education, some education, a lot of education, and significant education) obtained on SHT through a variety of means and level of interest in utilizing SHT in practice. A moderate positive correlation was found (*rho* (59) = .383, p =.001), indicating a significant relationship between the two variables. Participants with more education on SHT tend to have greater interest in incorporating SHT into practice. See Table 18 below for visual representation of the data.

Table 18

Correlation between Education and Interest

Correlation Coefficient	.383
Significance (2 tailed)	.001
N	59

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's level of interest in utilizing SHT in practice and perceived effectiveness when utilizing SHT. A moderate positive correlation was found (*rho* (22) = .368, $p < .05$), indicating a significant relationship between the two variables. Participants who have greater levels of interest in incorporating SHT into practice tend to have greater levels of perceived effectiveness with SHT in practice. See Table 19 below for visual representation of the data.

Table 19

Correlation between Interest and Perceived Effectiveness

Correlation Coefficient	.368
Significance (2 tailed)	.05
N	22

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's level of interest in utilizing SHT in practice and whether they were currently using SHT (yes/no). A moderate positive correlation was found (*rho* (59) = .410, p = .001), indicating a significant relationship between the two variables. Participants who are currently using SHT tend to have greater levels of interest with incorporating SHT in their practice. See Table 20 below for visual representation of the data.

Table 20

Correlation between Interest and Use

Correlation Coefficient	.410
Significance (2 tailed)	.001
N	59

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's perceived level of knowledge on SHT and level of comfort with utilizing SHT. A moderate positive correlation was found (*rho* (22) = .556, p = .002), indicating a significant relationship between the two variables. Participants who have greater levels of perceived knowledge on SHT tend to have greater levels of comfort with utilizing SHT in practice. See Table 21 below for visual representation of the data.

Table 21

Correlation between Perceived Knowledge and Comfort

Correlation Coefficient	.556
Significance (2 tailed)	.002
N	22

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's perceived level of knowledge on SHT and perceived effectiveness when utilizing SHT. A moderate positive correlation was found (*rho* (22) = .516, *p* = .005), indicating a significant relationship between the two variables. Participants who have greater levels of perceived knowledge on SHT tend to have greater perceived effectiveness when utilizing SHT in practice. See Table 22 below for visual representation of the data.

Table 22

Correlation between Perceived Knowledge and Perceived Effectiveness

Correlation Coefficient	.516
Significance (2 tailed)	.005
N	22

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's level of perceived knowledge on SHT and whether they were currently using SHT (yes/no). A moderate positive correlation was found (*rho* (59) = .487, *p* = .000), indicating a significant relationship between the two variables. Participants who are currently using SHT tend to have greater levels of perceived knowledge with incorporating SHT in their practice. See Table 23 below for visual representation of the data.

Table 23

Correlation between Perceived Knowledge and Use

Correlation Coefficient	.487
Significance (2 tailed)	.000
N	59

A Spearman *rho* correlation coefficient was calculated for the relationship between participant's level of comfort with utilizing SHT in practice and perceived effectiveness when utilizing SHT. A strong positive correlation was found (*rho* (25) = .854, p = .000), indicating a significant relationship between the two variables. Participants who report higher comfort with utilizing SHT tend to perceive greater effectiveness when utilizing SHT in practice. See Table 24 below for visual representation of the data.

Table 24

Correlation between Comfort and Perceived Effectiveness

Correlation Coefficient	.854
Significance (2 tailed)	.000
N	25

A Spearman *rho* correlation coefficient was calculated for the relationship between currently receiving funding (yes/no) for utilizing SHT in practice and whether they were currently using SHT. A strong positive correlation was found (*rho* (73) = .720 p = .000), indicating a significant relationship between the two variables. Participants who are currently using SHT tend to currently have funding in place for incorporating SHT in their practice. See Table 25 below for visual representation of the data.

Table 25

Correlation between Funding and Use

Correlation Coefficient	.720
Significance (2 tailed)	.000
N	73

CHAPTER V

DISCUSSION

Purpose

The purpose of this study was to inquire about the use of smart home technologies (SHT) by occupational therapy practitioners (OTPs) in practice. Additionally, the researchers were interested in what facilitators and barriers may impact the use of SHT as an intervention. The researchers developed one overarching research question, along with two additional sub-questions that will further be presented in this chapter as "the first sub-question" and "the second sub-question". They are as follows: What is the utility of smart home technology within occupational therapy practice?

- What relationships exist (if any) between factors identified and reported with use of SHT?
- What relationships exist (if any) between factors identified and reported with perceived effectiveness with SHT?

Summary

Participants of this study primarily practiced occupational therapy in the areas of productive aging (24%) and rehabilitation and disability (62.7%). The majority of participants served the older adult population (62.7%) by working in settings such as home health care and skilled nursing facilities. The literature also supports the notion that OTPs are likely to use SHT with the older adult population (Giger & Markward, 2011) in home health, long term care, and assisted living settings (Burrows et al, 2018;

McKeough, 2019; Orlov, 2019). This is likely due to the fact that many older adults are interested in aging in place and there are many opportunities to use SHT in the aforementioned areas of practice.

The researchers were interested in gathering data about where OTPs obtained education on SHT as an occupational therapy intervention. Education and continuing education are hallmarks and necessities of the practice of the occupational therapy profession. There is an ethical obligation for OTPs to have education on technology, and therefore SHT (AOTA, 2015). Participants of this study reported receiving the greatest amount of education on SHT through independent research and by attending general conferences. Perhaps the most important data point regarding SHT education was that the majority of participants did not receive any education in SHT while in OT school. That being said, the researchers did not find any literature identifying where OTPs were receiving education and training on the topic of SHT.

The first sub-question the researchers looked to answer was the overall use of SHT in occupational therapy practice. Approximately one-third (37.3%) of the participants of this study indicated that they are utilizing SHT in their practice, leaving 62.7% that were not using SHT. There was no literature found by the researchers that determined the overall use of SHT by practitioner. In addition to overall use, the researchers were interested in what factors may have influenced occupational therapy practitioners to use or not use SHT. This leads to the second research question which focused on exploring factors that were identified influencing the use of SHT. The data highlighted four factors that were found to have a correlation with the use of SHT in practice, which included support, interest, knowledge, and funding. A relationship was

found between the utilization of SHT in practice and the sources of support (co-workers, friends, and family) as well as the degree (slight, some, moderate, full) of support that the participant received in regards to SHT. The literature also shows that sources of support may influence the use of technology in practice, specifically support from within the workplace (AOTA, 2019a; Proffitt et al., 2019). A correlation was also found between interest and use, suggesting that the more interested a practitioner was in SHT, the more likely they were to use it as an intervention. This finding was also supported by the literature (Verdonck et al., 2011). The researchers found a relationship between use of SHT and the amount of perceived knowledge a practitioner had about SHT. This indicates the higher a practitioner perceived their knowledge to be, the more likely they were to use SHT. Interestingly, one finding from the literature found that although 84% of practitioners believed they could use SHT effectively in practice due to their knowledge base, only 34% were actually able to use SHT while using their own knowledge base (Verdonck et al., 2011). This point raises the question of what is the relationship between perceived knowledge, use, and effectiveness. The last factor found to correlate with use of SHT was funding, indicating a relationship between these two variables. Interestingly, funding was found to be the most commonly cited barrier to using technology as an intervention, by both clients and OTPs (Dicianno et al., 2019; Hamblin, 2017).

The second sub-question investigated the factors influencing the perceived effectiveness of occupational therapy practitioners when implementing SHT in practice. The researchers found that three factors were shown to relate to practitioners' perceived effectiveness. The three factors include knowledge, interest, and comfort. Over half of

the participants responded that they have at least some knowledge about SHT and the relationship with the variable of effectiveness suggests that individuals need to have some knowledge about SHT in order to feel effective when using it as an intervention. In addition, a common barrier, found in the literature, for the nonuse of technologies of interventions was the lack of knowledge. This includes limited knowledge of charging policies when using technology (Hamblin, 2017) and the jargon that is used amongst technological products (Proffitt et al., 2019). In relation to interest in SHT, the data suggests that practitioners that have more interest in SHT perceive that they are more effective when using it as an intervention than those who have less interest in the topic. Lastly, the data suggests that individuals that are more comfortable with these technologies are also more likely to perceive that they are effective with using SHT in practice. Though the researchers found relationships between perceived effectiveness and comfort, perceived effectiveness and interest, there was no literature found at the time of the study that corroborated these relationships.

Throughout the data analysis process, the researchers found several other correlations and relationships of note with the variables of availability, support, education, and knowledge. A correlation with the variable of availability was established with the factors of interest, support and funding. These relationships suggest that the more interest, support, and funding a practitioner has in and for SHT the more likely that they will have it available for them to use in practice. Correlations with the variables of access and funding were also established in the literature. The literature suggests that access to high technology is a barrier to using it in practice (Hoogerwerf et al., 2002). In addition, the literature suggests that a common obstacle that practitioners experience

when attempting to use technology in practice are the intensive process of obtaining insurance approval for device, cost of device, availability of funding, and time it takes to obtain authorization and equipment (Dicianno et al., 2019), thus limiting the availability of SHT.

Correlations were also found between the variable of support with funding and interest. This suggests that the more support an individual experiences, the more likely they will also have funding to use SHT and they may have more interest to use it as an intervention. That being said, no literature was found by the researchers on the relationships between the aforementioned variables. In addition to the aforementioned relationships, education was also found to correlate with the variable of interest. This suggests that the more interest a practitioner has regarding SHT, the more education the practitioner has received about the topic. The literature also suggests a relationship between these two factors. Jiancaro et al. (2017) indicated that participants were drawn to use technology in practice and were interested in obtaining additional education in technology and were able to identify that they valued learning more about technology and using technology in practice. Lastly, the researchers established a correlation between the variables of knowledge and comfort. This suggests that the more knowledge a practitioner has about SHT the more comfortable they will be to use it as an intervention within their practice. This relationship was also detected in the literature but was interpreted to be a barrier. Specifically, practitioner's lack of knowledge on some aspects of using technology was a distinct barrier for practitioners to be comfortable when using technology with their clients (Hamblin, 2017).

Implications

As stated previously, only 37% of the participants in this study actually used SHT in their practice. The researchers assert that there are key factors that are either assisting practitioners in their use of SHT or hindering their use and access of it. First supports for SHT will be identified and then barriers of utilizing SHT will be discussed. The biggest support to using SHT indicated by participants was their co-workers. In addition, the higher degree of support an OTP has to use SHT the more likely they are to be using it in practice as well. This information suggests that if an OTP has support from their colleagues and leaders in the workplace to use this technology they will be more likely to use it as an intervention with their clients. Moreover, the community and workplace are areas of opportunity to share more about SHT which ties into the workplace culture. This shows a need for support and access to SHT and it calls for leaders in the workplace to provide support and resources to their colleagues. A way for people to gather ideas and resources about SHT is to start a community of practice focused on the topic. Using social media is a strong outlet for communities of practice. With the recent increase in social media use, communities of practice on these platforms will likely grow in the future.

Another support that has been identified is the practitioner's interest in SHT. Interest in the topic is linked to increased support, increased access to funding, and increased availability. That being said, it was found that interest in the topic did not necessarily mean that a practitioner perceived they were effective when using it as an intervention, therefore an OTP's interest in SHT is not a driving force for it to be an effective intervention. It was found that comfort with SHT was a driving force for

practitioners to perceive they were effective when using it as an intervention. Though the topic of SHT is vast and may be overwhelming to a practitioner, practitioners should take interest in it because of the boundless opportunities it has to assist clients in their achievement of independent and meaningful lives and there is an ethical obligation for practitioners to use and investigate updated technologies and information in practice. Smart home technology should be used in care and when a practitioner takes a moment to develop interest in the topic, and hence develops a better understanding and knowledge base, they will likely have an increase in comfort and therefore, perceived effectiveness when using technologies as interventions. All of these factors assist clients in the long run. In summary, the biggest supports for using SHT participants indicated included co-workers and workplace culture, interest in SHT, and comfort with using SHT.

There were three barriers that were most often cited by participants which included availability, funding, and education. The majority of participants indicated that they did not have availability to access SHT, more specifically, they did not have time or access to these technologies. This suggests that OTPs may not have immediate resources to utilize in regards to SHT. This may be linked to ease of access to information, lack of information, or lack of time to inquire about SHT. This information suggests that more informative resources need to be developed by the occupational therapy profession, whether in research articles, conferences, or a simple OT Practice article. This is no different than other types of assistive technology interventions that may have had a lack of availability early on. There are certain factors that can be addressed to change availability from a barrier to a support to using SHT in practice including access to information, increased funding and insurance coverage, a commitment by practitioners to

spend their time resources, and a pledge by administrative and workplace leaders to take action on increasing SHT availability both for their colleagues and clients.

Funding was a barrier that was strongly represented in the literature and was also strongly represented in the data in this study. The obstacle of funding has two components to it. One, there is not funding available to the practitioner to use it through their workplace. This means that a practitioner may not have the opportunity to work directly with the devices before using them in intervention. This may affect an OTPs decision to use SHT as an intervention because the practitioner may not have any other experiences they can fall back on when it comes to SHT devices. The second part of the funding obstacle relates to the clients. Over half of participants indicated that there were no funding sources outside of their workplace for SHT. This suggests that there SHT is not currently being covered under insurance, both private and public, and there also may be a lack of grant funding available. The lack of these funding sources has implications for the client because even if SHT would be a good intervention and assistive device for the client, the client may not be able to afford the necessary devices out of pocket. This too may be an implication for the lack of use of SHT as an intervention. Practitioners should take time to advocate for increased funding for SHT in their workplace and from insurance companies, just like they would with other AT, such as wheelchairs. In the very least, managers and administrative leaders should take the time to investigate funding sources that may be available, such as grants and private donations. In addition, AOTA should advocate for the role of SHT in practice and therefore should advocate for the reimbursement of SHT interventions by CMS. If CMS were to provide coverage for SHT

it is likely that private insurance companies would do so as well. These changes have the potential to increase the quality of life for many clients.

Occupational therapy practitioners have an ethical obligation to stay up to date with technologies, and in order to do this education and training is needed. Therefore, perhaps the most important data point regarding SHT education is that 82% of participants received little to no education about SHT while they were in occupational therapy school. Occupational therapy programs need to provide more education on the use of SHT in order to stay in tune with the times and meet their ethical obligations. The lack of education of SHT also likely contributes to the overall nonuse of SHT as an intervention. Occupational therapy students that are currently in school now and those that will be entering school in the future have likely all grown up with using technology. Therefore, they have an increased level of technological literacy than perhaps those who are already established in practice. Consequently, ACOTE could easily update standards to include SHT as a skill required for entry level practice. This would mandate programs to include these updated technologies in their curriculums. SHT is here now and will only continue to increase in use in the future. Including it in curriculums is no different than including other assistive technologies. Not only do schools and ACOTE have a call to include this topic, they have a moral and ethical responsibility to do so. The fact that this is not being incorporated in professional programs is reprehensible.

Limitations

Limitations of this study include the survey design, confusing or misleading structure of survey question wording, errors in initial grouping of data and difficulties

with correlation data, unidentified correlations in relation to other factors (e.g. education) in the research, and finally missing survey responses.

When considering survey design, the researchers of the study took careful consideration in creating the survey before distributing it via the social media pages. However, after completing the data analysis and writing up the results and implications, the researchers found that there was little variety in question type, resulting in more simple yes/no question answers with little room for clarification. The survey did contain some open-ended questions, allowing the participant to answer the "other" option and explain if the answer options for said questions were not appropriate. However, the researchers chose not to analyze this information or include many of the responses, as there were very few that chose to answer "other" and explain when appropriate. When considering the survey design after data collection, the researchers believe the question order could have been reworked and reorganized in a more fluid fashion. After asking more descriptive questions in nature, there was a question regarding smart home technology use along with a definition and examples. This definition and examples were examined through the lenses of the two occupational therapy students, and the student researcher's advisor, an occupational therapy professor and PhD holder. All individuals believed this definition to be understandable; however, the researchers believe the definition and example could have been written differently in order for better understanding and an increased likelihood that participants would answer the remainder of the questions in relation to the definition. The researchers believe that this definition was either skipped entirely or misunderstood in relation to how some participants answered questions throughout the survey, thus leading to possible skewed data.

Another limitation evident throughout the research was errors in initial data groupings. The student researchers do not claim to be experts in data analysis and knowing appropriate tests to run while using SPSS in relation to a variety of survey questions and the data collected. After completing initial data analysis and moving forward in writing results, the student researchers found skewed data in relation to poor data groupings, and finding minimal and incorrect correlations between variables. This led the student researchers to start the data analysis process over and regroup the data into new groupings, along with the assistance of a research consultant, who assisted greatly in grouping our variables and providing guidance while using SPSS. This provided for greater understanding and presentation of the data moving forward, especially when analyzing and presenting relationships in the data.

When considering the survey design and multiple reassessments of the data, the researchers found a limitation with limited correlation relationships in regards to the variables being studied. There were many correlations that showed importance in regards to *support, interest, knowledge,* and *funding*, as well as other factors such as *use.* However, the researchers were also examining the relationship between education and availability in relation to the variables listed above. Through the data, there was little to support *use* with *education* and *availability,* which was of particular interest of the student researchers. This could have been due to the survey design, uncertainty of the student researchers when grouping variables, and possible skewed data due to the limitations stated above. Another possible limitation is the moderate frequency of missing survey responses, which created difficulties when analyzing the data and finding relationships between variables.

Recommendations

The researchers have identified several recommendations for the future study of smart home technology devices within occupational therapy practice. Additional studies should be completed to evaluate trends in devices and overall use of SHT. This is especially important now as the world, and occupational therapy practice, has been affected by the Corona Virus pandemic and the use of technology, both to engage in practice and as an intervention, has likely increased significantly given the circumstances. Furthermore, repeating this study in the future would be beneficial to identify changes in knowledge, attitudes, current practices, perceived barriers and supports, years of experience and active involvement by practitioners in future years with SHT. The aforementioned studies would be beneficial for the profession to know what SHT is being used by professionals and how successful the use of technology was for their clients. In addition, it is our recommendation that more education be available to current and future occupational therapy practitioners. This can be done by occupational therapy programs, including more information about updated technologies in their curriculum as well as including the topic of smart home technology in specialty and general conferences.

Conclusion

Occupational therapists have an ethical and moral obligation to use the best available interventions for their clients to assist their clients in leading more independent and meaningful lives. It has been shown throughout this paper that SHT has the potential to be the intervention that allows individuals to lead more independent and meaningful lives. Therefore, OTPs should, in theory, be using these devices in their practice. Sadly, the data from this study point to the fact that the majority of practitioners are not using it

as an intervention even though they are working in areas and populations, such as productive aging, rehabilitation, home health and the older adult population, that would see the most benefit from the utilization of these devices.

The most substantial barriers to using SHT that were identified include lack of funding sources, lack of education, and lack of availability to the devices. These factors do not need to remain barriers and in fact can and should become supports to using SHT. Though the data from this study and literature support the use of SHT as an intervention for older adults in particular, it has the potential to assist individuals in other settings as well. For example, individuals with intellectual and developmental disabilities, and individuals who may have physical disabilities such as a spinal cord injury.

Occupational therapy practitioners are creative in nature and should use the tool of SHT creatively as well to assist their clients in obtaining independence and increased quality of life. Smart home technology has boundless potential in the hands of occupational therapy practitioners. Practitioners should not let the opportunity to use these tools pass as other professions certainly will not. “Occupational therapists cannot be leaders in this new era unless we set aside our fears and embrace the potential benefits of technologies” (Liu, 2018, p. 281).

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APPENDIX A

QUALTRICS SURVEY TOOL

What is your identified gender?

Male | Female | Prefer not to answer

Select the age range you fall within.

20-30 | 31-40 | 41-50 | 51-60 | 61+ | Prefer not to answ

How many years have you been a registered and licensed OT or OTA?

1-4 yrs. | 5-10 yrs. | 11-15 yrs. | 16-20 yrs. | 21-25 yrs. | 26+ yrs.

Where do you currently practice?

- United States of America
- Internationally; please specify country

What best describes your geographical area of practice?

Rural | Metropolitan

What is your title?

OT | OTA

What is your highest educational degree earned?

- Bachelors
- Masters
- Research Doctorate (Ph.D/Ed.D)
- Clinical Doctorate (OTD)

What populations do you serve? (Select all that apply)

- Pediatrics
- Adolescents
- Adults
- Older Adults

What settings do you practice in? (Select all that apply)

- Inpatient/Acute
- Outpatient
- Skilled Nursing Facility/Transitional Care Unit
- School System
- Home Health/In-home
- Other:

What areas best describe your practice focus, based on AOTA's practice areas (Select all that apply)

- [ ] Children/Youth
- [ ] Health & Wellness
- [ ] Mental Health
- [ ] Productive Aging
- [ ] Rehabilitation & Disability
- [ ] Work & Industry
- [ ]

Are you a certified Assistive Technology Practitioner (ATP)?

- ○ Yes
- ○ No

Smart Home Technology

Definition of smart home technology:

A smart home is an environment that adopts information and communications technology to collect and share information, analyze and monitor residents' behavioral patterns, and, finally, improve residents' quality of life within the home. Smart home technologies are also able to link individuals to services and systems outside of the home (Brandt, Samuelsson, Toytari, & Salminen, 2011; Courtney, 2008). Some examples of smart home technology include, an in home monitoring system, an artificial intelligence device that controls aspects of the home such as lighting and temperature, sensors placed throughout the home that alert if the resident has fallen or left the oven on.

Identify amount of education you have gained about smart home technology through the following means.

	No education	Little Education	Some Education	A lot of Education	Significant Education
While in OT school	○	○	○	○	○
Independent research/study	○	○	○	○	○
Informal in-services (lunch & lea rns, etc.)	○	○	○	○	○
Continuing Education Conferenc es - General	○	○	○	○	○
Continuing Education Conferenc es - Specialty	○	○	○	○	○
Other:	○	○	○	○	○

In the last 5 years, how much time have you spent researching smart home technology, either at work or at home?

- ○ None
- ○ Less than 1 hr/wk
- ○ 1-5 hrs/wk
- ○ 6-10 hrs/wk
- ○ 10+ hrs/wk

In the last 6 months, how much time have you spent researching smart home technology, either at work or at home?

- ○ None
- ○ Less than 1 hr/wk
- ○ 1-5 hrs/wk
- ○ 6-10 hrs/wk
- ○ 10+ hrs/wk

Do you incorporate smart home technology into your practice?

- Yes
- No

How often do you use smart home technology in your OT practice?

Never	Seldom	Occasionally	Almost always	Always

How many years have you been utilizing smart home technology in your OT practice?

- 0-5 yrs.
- 6-10 yrs.
- 11-15 yrs.
- 16-20 yrs.
- 21+ yrs.

Rate your comfort with using smart home technology.

1 = not at all	2 = slightly	3 = somewhat	4 = moderately	5 = extremely

Rate your effectiveness in utilizing smart home technology.

1 = not at all	2 = slightly	3 = somewhat	4 = moderately	5 = extremely

What sources of funding have you utilized to access smart home technology for clients. (Check all that apply)

- [ ] Private pay
- [ ] Grant funding
- [ ] Private donation
- [ ] Private medical insurance
- [ ] Government funded medical insurance (Medicare, Tricare, state supported)

Identify supports you have encountered regarding the use of smart home technology. (Check all that apply)

- [ ] Co-worker(s)
- [ ] Mentor(s)
- [ ] Professional organization
- [ ] Special interest group/community of practice
- [ ] Friends
- [ ] Family
- [ ] Other:

Personal Interest

Rate the level of your personal interest in using smart home technology.

Not at all interested	Slightly interested	Somewhat interested	Moderately interested	Extremely interested

Please state why you are not interested in smart home technology
(Ex. Do not see how it is applicable to practice)

Rate your interest in researching more about smart home technology use.

Not at all	Slightly	Somewhat	Moderately	Extremely
○	○	○	○	○

Rate your knowledge on smart home technology.

No knowledge	Slight knowledge	Some knowledge	Moderate knowledge	Extreme knowledge
○	○	○	○	○

Do you feel that you have time to implement smart home technology with clients?

- ○ Yes
- ○ No

Do you have access to smart home technology products and resources?

- ○ Yes
- ○ No
- ○ Unsure

Does your current employer provide funding for trial use of smart home technologies with clients?

- ○ Yes
- ○ No
- ○ Unsure

Do you have access to other funding **sources** (outside of employer support) for implementing smart home technology (ie. grants, insurance)?

- ○ Yes
- ○ No
- ○ Unsure

Rate the level of support within your place of work in utilizing smart home technology.

No support	Slight support	Some support	Moderate support	Full support
○	○	○	○	○

APPENDIX B

IRB APPROVAL

UND IRB approval letter

Bowles, Michelle
Fri 7/26/2019 3:53 PM
To: Zimmer, Jessie; Walthers, Kylie; **Cc:** Graves, Cherie

UNIVERSITY OF NORTH DAKOTA UND.edu

Institutional Review Board
Tech Accelerator, Suite 2050
4201 James Ray Drive Stop 7134
Grand Forks, ND 58202-7134
Phone: 701.777.4279
Fax: 701.777.2193
UND.irb@UND.edu

July 26, 2019

Principal Investigator(s):	Kylie Walthers and Jessie Zimmer
Project Title:	The Utility of Smart Home Technology Within Occupational Therapy Practice
IRB Project Number:	IRB-201907-013
Project Review Level:	Exempt 2
Date of IRB Approval:	07/26/2019
Expiration Date of This Approval:	07/25/2022

The application form and all included documentation for the above-referenced project have been reviewed and approved via the procedures of the University of North Dakota Institutional Review Board.

If you need to make changes to your research, you must submit a Protocol Change Request Form to the IRB for approval. No changes to approved research may take place without prior IRB approval.

This project has been approved for 3 years, as permitted by UND IRB policies for exempt research. You have approval for this project through the above-listed expiration date. When this research is completed, please submit a Termination Form to the IRB.

The forms to assist you in filing your project termination, adverse event/unanticipated problem, protocol change, etc. may be accessed on the IRB website: http://und.edu/research/resources/human-subjects/

Sincerely,

Michelle L. Bowles, M.P.A., CIP
IRB Manager

Cc: Cherie Graves, MOT, OTR/L

Michelle L. Bowles, M.P.A., CIP
Manager, Ins tu onal Review Board
University of North Dakota

Tech Accelerator, Suite 2050
4201 James Ray Drive Stop 7134
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P: 701.777.4279
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Michelle.Bowles@UND.edu
[UND.edu/research/resources/human-subjects/]UND.edu/research/resources/human-subjects/

APPENDIX C

STATEMENT OF INFORMED CONSENT

The University of North Dakota
Consent to Participate in Research

Project Title: The Utility of Smart Home Technology Within Occupational Therapy Practice

Principal Investigators:
Kylie Walthers; Jessie Zimmer

Email Address:
kylie.walthers@und.edu; jessie.n.zimmer@und.edu

Department: Occupational Therapy

Research Advisor: Cherie Graves

Research Advisor
Phone/Email Address:
701-777-6086
cherie.graves@und.edu

Purpose of the Study:
The purpose of this study is to explore occupational therapists utility of smart home technology in their practice. Additionally, the student researchers will inquire into the facilitators and barriers of utilization of smart home technology within the practice of occupational therapy.

Procedures to be followed:
You are being asked to complete an online survey.

Risks:
There are no risks in participating in this research beyond those experienced in everyday life.

Benefits:
The results of this study will better inform occupational therapy practitioners of the use of smart home technology and the barriers and facilitators experienced when smart home technology is implemented by occupational therapy practitioners. Results may impact

the use of smart home technology by occupational therapists within the profession that are currently practicing in many different settings.

Duration:
It will take approximately 15 minutes to complete the survey.

Statement of Confidentiality:
No identifying information will be collected on this survey. All data will be stored and analyzed in a private setting, and only the researchers and our advisors will have access to the data. You should complete the survey in a private location to ensure confidentiality while you are completing the survey. If this research is published, you will not be identified as your name is not collected and cannot be linked to your responses in any way.

All survey responses that we receive will be treated confidentially and stored on a secure server. However, given that the surveys can be completed from any computer (e.g., personal, work, school), we are unable to guarantee the security of the computer on which you choose to enter your responses. As a participant in our study, we want you to be aware that certain "key logging" software programs exist that can be used to track or capture data that you enter and/or websites that you visit.

Right to Ask Questions:
The researchers conducting this study are Kylie Walthers and Jessie Zimmer. If you have questions, concerns, or complaints about the research please contact Cherie Graves, with any questions at (701) 777-6086.

If you have questions regarding your rights as a research subject, you may contact The University of North Dakota Institutional Review Board at (701) 777-4279 or UND.irb@UND.edu. You may contact the UND IRB with problems, complaints, or concerns about the research. Please contact the UND IRB if you cannot reach research staff, or you wish to talk with someone who is an informed individual who is independent of the research team.

General information about being a research subject can be found on the Institutional Review Board website “Information for Research Participants” http://und.edu/research/resources/human-subjects/research-participants.html

Compensation:
You will not receive compensation for participation.

Voluntary Participation:
You do not have to participate in this research. You can stop your participation at any time. You may refuse to participate or choose to discontinue participation at any time

without losing any benefits to which you are otherwise entitled.

You do not have to answer any questions you do not want to answer.

You must be 18 years of age older to participate in this research study.

Completion of the survey implies that you have read the information in this form and consent to participate in the research.

Please keep this form for your records or future reference.