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INTENTIONS TO USE TELEREHABILITATION FOR COMMUNICATION AND TREATMENT FOR VISION IMPAIRMENTS

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INTENTIONS TO USE TELEREHABILITATION FOR COMMUNICATION AND TREATMENT FOR VISION IMPAIRMENTS

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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Dedications

to Kylie, Joseph, Sarah, Aniston, Christopher, Dylan, and Joshua

your love and encouragement have been my strength and light through this long journey

to Albert Copolillo, PhD, OTR/L, FAOTA,

for being a great mentor and teacher

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Abstract

INTENTIONS TO USE TELEREHABILITATION FOR COMMUNICATION AND TREATMENT FOR VISION IMPAIRMENTS

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BACKGROUND: Approximately 8.1 million people in the United States 18 and older have difficulty performing one or more daily activities because of vision impairment or blindness (Erickson, Lee, & von Schrader, 2020; Taylor, 2018). If the impairments caused by vision loss are not addressed, they can result in financial difficulties, suffering, disability, loss of productivity, and decreased quality of life (National Center for Chronic Disease Prevention and Health Promotion, 2011). Currently, in-person low vision rehabilitation services are the gold standard for teaching people how to adapt to and compensate for these deficits, however, the access and utilization of these services by people with vision impairments is poor. Telerehabilitation is one service delivery option that has been used in other settings to increase access and utilization of low vision services. This study investigated the underlying factors that are related to three stakeholder groups' behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option.

METHODS: This pilot study utilized an anonymous pre-validated online survey to collect data from people with vision impairments, eye care professionals, and vision rehabilitation professionals. Participants were recruited by email or through social media.

RESULTS: Fifty-two people participated in the survey – 12 males (23%) and 40 females (77%). Participants' ages ranged from 21 to 79 years of age (M = 45.2, SD = 12.6). Twenty-two people with vision impairments (42%) participated in the survey, followed by 21 (40%) vision rehabilitation professionals, and nine (17%) eye care professionals. Most of the participants reported feeling very comfortable with using computers (85%), mobile devices (85%), and videoconferencing software (64%). More than half of the sample reported being very skilled using computers (70%), mobile devices (76%), and videoconferencing programs (59%). All participants, except for one, reported using a computer for at least 1 year. Twenty-one participants – 3 people with vision impairments, 3 eye care professionals, and 15 vision rehabilitation professionals - reported having used telerehabilitation.

Twenty participants (43%) reported having the behavioral intention to use telerehabilitation in the future while 17 participants (36%) stated that they planned on using telerehabilitation in their daily lives. For this study's adapted and extended UTAUT model, small effect size relationships were noted between behavioral intention and performance expectancy (r = .295), and behavioral intention and resistance to change (r = .254). Age, gender, and experience were not found to be confounding variables between the predictor variables and behavioral intention. The people with vision impairment group was noted to have small effect sizes for the relationships between behavioral intention and performance expectancy (r = .218), and effort expectancy (r = .271), and technology anxiety (r = -.321). Age, gender, or experience were not found

to act as confounding variables in these relationships. Eye care professionals had a moderate effect size for the relationship between behavioral intention and performance expectancy (r = .414) which appeared to be confounded by gender (r = .830) and experience (r = .671). They also had a small effect size relationship between behavioral intention and technology anxiety (r = .213) which appeared to be confounded by experience (r = .515). Gender and experience were also noted to be confounding variables for the relationship between behavioral intention and resistance to change. Age, gender, or experience were not found to act as confounding variables in these relationships. For the vision rehabilitation group, there was only one small effect size found for the relationship between behavioral intention and resistance to change (r = .243) which was noted to be confounded by experience (r = .463).

CONCLUSIONS: The use of telerehabilitation as a low vision service delivery option is still a new area of inquiry. This study was the first to explore the underlying factors of three stakeholder groups' behavioral intention to use telerehabilitation as a service delivery option. Most of the participants with vision impairments reported not having difficulty accessing traditional in-person low vision rehabilitation services, or not planning on using telerehabilitation services in the future. These findings were contrary to assertions made by previous literature (Lam and Leat, 2013; Hoque and Sorwar, 2017). Eye care professionals also reported being very comfortable and skilled with various technologies, but were more open to change and accepting of new technologies, like telerehabilitation. Therefore, eye care professionals' behavioral intention to use telerehabilitation in the future was higher than the other two groups. The vision rehabilitation group was similar to the eye care professional group in the

behavioral intention to use telerehabilitation, and similar to the people with vision impairments group in their high level of resistance to change. Like the people with vision impairments group, the vision rehabilitation professional group appeared to be satisfied with the in-person low vision rehabilitation services that are already being delivered, and may not recognize the need for another service delivery option at this time. This study provides preliminary information that can be used in future studies that seek to understand why different stakeholder groups choose to accept and plan to use telerehabilitation. Once this information is better understood, researchers can build upon this information to increase the actual use of telerehabilitation among all three stakeholder groups. Limitations of this study that impact the interpretation of this study's results and generalizability to a broader population are poor response rates, single survey response method, stringent inclusion criteria, and accessibility issues. Recommendations for future studies consist of addressing the study's limitations as well as the intrinsic and extrinsic factors of each stakeholder group's behavioral intention to use telerehabilitation. Overall, this study adds to the body of knowledge in the areas of telerehabilitation and low vision rehabilitation.

Keywords: Telerehabilitation, low vision rehabilitation, UTAUT, vision impairments

Chapter 1

Introduction

With this dissertation, I aim to investigate the behavioral intention of three stakeholder groups (i.e., people with vision impairments, eye care professionals, and vision rehabilitation professionals) to utilize telerehabilitation as a low vision rehabilitation service delivery option. A search of previous literature related to behavioral intention and the use of telerehabilitation in low vision rehabilitation found no studies that have researched this topic.

Vision is often recognized as our most important sense because it allows us to understand the information we receive from all of our other sensorimotor systems (Titcomb & Okoye, 2005). By integrating and unifying all of the information obtained from these other sensorimotor systems, the visual system helps us to learn about, interact with, and live in our world. Conditions or diseases that disrupt the visual system's ability to process key sensorimotor information can negatively impact people's ability to safely move around in their environment, effectively perform activities of daily living, and efficiently interact with objects and people (Centers for Disease Control and Prevention [CDC], 2010; CDC, 2011). If left untreated these difficulties can progress into depression, social isolation, personal and family stress, poor quality of life, and financial burdens for individuals with vision impairments, their families, and society. Currently, in-person low vision rehabilitation services are considered best practice in helping people with vision impairments adapt to and/or compensate for their visual deficits (Ganesh et al., 2013; Liu et al., 2013; Pearce, Crossland, & Rubin, 2011; Walter et al., 2007). However, a "clear mismatch [exists] between the need and the uptake of low-vision services" (Matti et al., 2011, p. 181). In fact, Lam and Leat (2013) found that the "rate and awareness of low vision services continues to be low, ranging from 29% to 75%" (p. 458). Therefore, a service delivery option that addresses the poor rate of access and utilization of low vision rehabilitation services, and, at the same time, can improve vision-related and health-related outcomes for people with vision impairments is needed.

Vision Impairment - A Leading Disability

Currently, 8.1 million adults in the United States have a vision impairment which is one of the top 10 disabilities among adults 18 years and older (CDC, 2011; U.S. Census Bureau, 2012). Visual impairments often result in difficulty performing one or more daily activities; they also contribute to increased social isolation, risk of falling and injury, depression, increased personal and family stress, and poor quality of life (CDC, 2010). These issues related to vision impairments place a significant financial burden on individuals, their families, and society that totals $139 billion in health care related costs, lost productivity costs, assistive device costs, and daily care costs. According to Chan et al. (2018), the incidence of moderate to severe vision impairments is anticipated to double over the next 30 years. This predicted increase in prevalence and incidence of people with moderate to severe vision impairments in the United States, especially among the elderly, reveals a significant increase in the need for low vision rehabilitation services in the near future.

Low Vision Rehabilitation Service Delivery Options

Self-Adaptation

One way people with vision impairments learn to overcome the challenges posed by vision loss is through learning how to adapt and/or compensate for vision-related deficits by trial and error. Many people with vision impairments use mainstream computer-based technology to support their daily activities (e.g., Crossland et al., 2014; Kaldenberg & Smallfield, 2016). The various adaptive technology devices and their uses are detailed in the following chapter.

In-person Low Vision Rehabilitation Services

Sometimes, the functional limitations caused by low vision are too significant for people with vision impairments to independently adapt or compensate for them or their vision impairments cannot be cured or reversed through medical treatment or surgery. In these instances, low vision rehabilitation services are needed to help individuals with vision impairments overcome their functional difficulties. Traditionally, low vision rehabilitation services have been delivered in-person through one of two service delivery models (i.e., the medical model or the educational model) which are explained further in the next chapter. These service delivery models differ in the funding of service provision, the location where services are delivered, the practitioners that deliver services, and the services provided, however, no evidence has shown that one service delivery model is more effective than the other (Owsley et al., 2009); instead, both models work towards accomplishing the same goals which include increasing functional independence in daily living activities and improving quality of life. In-person low vision rehabilitation services, regardless of the service delivery model, have been shown to effectively remediate many functional deficits associated with visual impairments, but many people with vision impairment either do not have access to these services or do not utilize the services that are available for various reasons (e.g., a lack of understanding of the long term consequences of vision impairments, presence of concurrent health problems, difficulty obtaining transportation to and from low vision rehabilitation appointments, and/or a perception that low vision rehabilitation services would not be helpful) (Lam & Leat, 2013; O'Connor et al., 2008; Overbury & Wittich, 2011; Southall & Wittich, 2012). This evidence suggests the need for a service delivery model that complements in-person low vision rehabilitation services.

Telerehabilitation

One service delivery option that is being used to complement in-person rehabilitation services in a variety of settings in order to increase clients' access to and utilization of rehabilitation services is the use of telerehabilitation (Barlow et al., 2009; Bendixen et al., 2008; Chumbler et al., 2010; Germain et al., 2009; Girard, 2007; Hermann et al., 2010; Kim et al., 2008; Tousignant et al., 2014). Telerehabilitation is "the application of evaluative, consultative, preventative, and therapeutic services delivered through telecommunication and information technologies" (American Occupational Therapy Association [AOTA], 2013, p. S69). This service delivery option provides rehabilitation professionals with a long distance mechanism to deliver services where clients live, work, and play (AOTA, 2013; Chumbler et al., 2010; Hermann et al., 2010; Tousignant et al., 2014). The benefits of telerehabilitation technology are increased accessibility of services to clients who live in remote or underserved areas, improved access to providers and specialists otherwise unavailable to clients, the prevention of unnecessary delays in receiving care, decreased isolation of healthcare providers through distance learning, and increased ability for healthcare providers to consult with one another as well as perform research (Cason, 2012). Two randomized controlled trials have found that the feasibility and effectiveness of delivering rehabilitation services using telerehabilitation is comparable to standard in-person rehabilitation practice (Chumbler et al., 2012; Tousignant et al., 2011). In the area of vision, the feasibility, benefits, and outcomes of using telehealth technology to deliver optometry and ophthalmology services in diagnosing, monitoring, and managing of residual visual functions have been supported by several studies which are reviewed in more detail in the following chapter (Mines et al., 2011; Sreelatha & Ramesh, 2016; Tan et al., 2013). These studies also indirectly provide support for the feasibility of using telehealth technology as a service delivery option in low vision rehabilitation.

Only four studies have focused on using telerehabilitation technology in providing low vision rehabilitation services. Three of the studies were small sample size quasi-experimental design studies that addressed using telerehabilitation to increase reading speed which, in turn, resulted in an improvement in vision-related quality of life (Bittner et al., 2017; Bittner et al., 2018; Ross et al., 2017). The other study utilized a retrospective design to determine cost savings associated with telerehabilitation and participants' acceptance of telerehabilitation as a low vision service delivery model (Ihrig, 2019).The study concluded that the provision of low vision rehabilitation services increased 24% when a telerehabilitation model was available, resulting in a reduction of miles, time, and cost spent traveling for each participant. In a satisfaction survey, all study participants reported that the telerehabilitation services were timely, confidential, secure, informational, and helpful in their daily lives.

Although these studies, which are discussed in more detail in the following chapter, provide evidence that low vision telerehabilitation services can improve the functional performance, social and psychological well-being, quality of life, and cost savings for people with vision impairments, the use of this model in the provision of low vision rehabilitation services among eye care professionals, vision rehabilitation professionals, and people with vision impairments is still quite limited. To date, no studies have explored the underlying reasons for this limited access and use of telerehabilitation among these stakeholder groups. Therefore, this study attempts to investigate the factors that influence the behavioral intention of these stakeholders to adopt and use telerehabilitation as a low vision service delivery option.

Acceptance and Use of Telerehabilitation Technology Theory

Though current research suggests that telerehabilitation is a viable solution to the challenges people with vision impairments face in accessing and utilizing low vision rehabilitation services (Bittner et al., 2017; Bittner et al., 2018; Bittner et al., 2020; Ihrig, 2016; Ihrig, 2019; Ross et al., 2017), public awareness, access, and utilization of low vision rehabilitation services of all kinds remains poor (i.e., between 29% to 75%) (Lam and Leat, 2013). Although telerehabilitation services have several advantages over traditional in-person low vision rehabilitation services, eye care professionals, vision rehabilitation professionals, and people with vision impairments have been slow to adopt and use telerehabilitation as a service delivery option (Bittner et al., 2020). Due to the lack of research in the adoption and use of low vision telerehabilitation services, there are many unanswered questions regarding the feasibility of implementing this service delivery option on a larger scale. Thus, prior to expending large amounts of time, energy, and money to implement low vision rehabilitation services that may or may not be adopted and used on a larger scale, research is needed to explore the underlying factors that influence key stakeholder groups' behavioral intention to access and utilize this technology as a supplement to in-person low vision rehabilitation services if and when they come available.

One theoretical framework that explains people's behavioral intention to either accept and use, or reject and discard, a piece of technology is the UTAUT (Venkatesh et al., 2003). This theory, which is described in more detail in the following chapter, is a valid, reliable, and robust framework for studying the behavioral intention to use new technology that can be adapted and/or extended to address a variety of different tools and settings (Venkatesh et al., 2003). The original theory consisted of five constructs (i.e., performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioral intention), but recent literature has demonstrated that the model can be adapted successfully for varying populations and contexts (e.g., Cimperman et al., 2016; Isaias et al., 2017; Malkani & Starik, 2014; Venkatesh et al., 2011). Since this study is applying the UTAUT to a new population and context which has not been previously addressed in the literature (i.e., the behavioral intention of clients and professionals to use telerehabilitation as a supplement to face-to-face low vision rehabilitation services), I have adapted and extended the UTAUT in order to appropriately address the scope of this research. These changes are described in Chapter 3.

Purpose Statement

In accord with the UTAUT theoretical framework as adapted for this population, the purpose of this pilot study is to survey and analyze relationships among performance expectancy, effort expectancy, technology anxiety, resistance to change, and behavioral intention to access and use telerehabilitation as a low vision service delivery option among eye care professionals, vision rehabilitation professionals, and people with vision impairments.

Hypotheses

This study poses the following hypotheses:

Hypothesis 1: The UTAUT model explains a relationship between the predictors and behavioral intention.

Hypothesis 2: Performance expectancy has a positive relationship with behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option adjusted for age and gender.

Hypothesis 3: Effort expectancy has a positive relationship with behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option adjusted for age, gender, and experience.

Hypothesis 4: Technology anxiety has a negative relationship with behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option adjusted for age, gender, and experience.

Hypothesis 5: Resistance to change has a negative relationship with behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option adjusted for age, gender, and experience.

Methodology

This quantitative, non-experimental, descriptive study utilized a cross-sectional survey design to assess the behavioral intention to use telerehabilitation technology as a supplementary low vision rehabilitation service delivery option for eye care professionals, low vision rehabilitation professionals, and people with vision impairments. This study utilized a pre-validated internet-based survey to collect data. This study's methodology is detailed in Chapter 3. The survey itself is attached as Appendix 1.

Rationale for this Study

Despite strong evidence in the literature regarding low vision rehabilitation's effectiveness and positive outcomes, an important problem that remains is the access and utilization of these services by people with vision impairments. One solution to this problem that is being used in other rehabilitation settings with various populations is telerehabilitation. Emerging evidence supports the viability of telerehabilitation services for people with low vision, suggesting that this option can help overcome transportation challenges, offer virtual in-home personalized care, expand the availability of providers who may live at a distance from their clients, and allow better management of time and resources for both clients and providers. Telerehabilitation services appear to have the potential to reach more people earlier, potentially reducing their decline in functional ability and the accompanying burden placed on caregivers and society.

The rationale for this study is four-fold: (1) it will pilot test a survey designed to collect data from people with vision impairments, eye care professionals, and vision rehabilitation professionals regarding their behavioral intention to use low vision telerehabilitation services which can be used later on a larger population; (2) this study will provide the first evidence on the behavioral intention of people with vision impairments and the professionals who work with them to use low vision telerehabilitation services; (3) the study will provide evidence to support an adapted and expanded version of the UTAUT in relation to behavioral intention to use telerehabilitation services in the area of low vision rehabilitation; and (4) it will explore the relationships between behavioral intention and the variables that are thought to predict behavioral intention to use low vision telerehabilitation services.

Chapter 2

Introduction

This chapter reviews research literature on the topic of low vision rehabilitation and the emerging heath service technology of telerehabilitation, which promises more widespread, affordable, and accessible rehabilitation options for people with low vision. This chapter first discusses the significant number of people in the United States that are affected by vision impairments, a number that is expected to increase considerably over the next couple of decades due to the aging of the population. These vision impairments have been noted to often result in impaired self-care and community participation, depression, increased social isolation, and decreased productivity and quality of life. Next, this chapter discusses the low vision rehabilitation services that are available to help people with vision impairments resolve their occupational performance dysfunction in the United States. These services are currently delivered in person in a variety of settings, such as people's homes, work, schools, etc. However, people's awareness, access, and utilization of these low vision rehabilitation services are severely lacking due to a wide variety of barriers, like limited availability of low vision services, lack referral for low vision services by ophthalmologists and optometrists, and difficulty obtaining transportation. The third section of this chapter reviews emerging research on a telerehabilitation which has been defined as the "application of evaluative, consultative, preventative, and therapeutic services delivered through telecommunication and information technologies" (AOTA, 2013, p. S69). The fourth section of this chapter discusses Venkatesh et al.'s (2003) Unified Theory of Acceptance and Use of Technology (UTAUT), which I have adapted as a framework to guide my survey and analysis of the behavioral intention of key stakeholders' (i.e., ophthalmologists and optometrists, low vision rehabilitation professionals, and people with vision impairments) to use telerehabilitation as a low vision rehabilitation service delivery option. Finally, this chapter summarizes key gaps in the current research. Chapter Three describes the methodology for this study, which addresses those gaps.

Impact of Vision Impairments

Vision impairment has a significant impact on millions of individuals, their families and/or caregivers, and society that result in financial difficulties, suffering, disability, loss of productivity, and decreased quality of life (National Center for Chronic Disease Prevention and Health Promotion, 2011). Individuals who are visually impaired or blind often report having difficulty with many daily activities, such as grooming and hygiene, dressing, cooking, cleaning, driving, reading, learning, watching television, and performing household tasks. These deficits often result in increased social isolation, risk of falling and injury (e.g., hip fractures), depression, personal and family stress, and decreased quality of life.

Vision Impairment Statistics

Currently in the United States, there are approximately 12.3 million adults ages 18 and older who report having difficulty performing one or more daily activities due to a vision impairment or blindness (Erickson, Lee, & von Schrader, 2020; Taylor, 2018). Over the next three decades, these numbers are expected to double due to the aging of the U.S. population (National Center for Chronic Disease Prevention and Health Promotion, 2011). These statistics show how visual disabilities have become one of the top 10 disabilities among adults 18 years and older (Centers for Disease Control, n.d.).

The impact visual disabilities have on society is typically reported as cost, both direct and indirect (Centers for Disease Control, n.d.). Wittenborn and Rein (2013) estimated the total annual cost to the U.S economy, including direct and indirect costs, related to eye disorders and vision loss as $139 billion. Direct costs, such as medical visits and care, medical vision aids, vision assistive devices and adaptations, and rehabilitation and assistance programs, account for $66.8 billion, or 48% of the total annual cost. Indirect costs, like informal care, long term care, entitlement programs, and lost productivity, account for $72.2 billion, or 52% of the total annual cost. These cost related findings reveal that visual disabilities are one of the costliest conditions to the U.S. economy. These numbers are expected to increase, with rising healthcare costs and the aging population.

Low Vision Rehabilitation Services

In the United States, low vision rehabilitation services are delivered through one of two vision rehabilitation service delivery models – (1) the education model, or (2) the medical rehabilitation model (Berger, 2013; Ryan, 2014). The education model delivers low vision rehabilitation services through each state's vocational rehabilitation agency system and has a primary focus of assisting working-age adults with vision impairments to enter or return to the workforce by providing financial assistance for education, low vision compensatory and adaptive techniques, orientation and mobility services, assistive device evaluation and training, and employment services. The low vision rehabilitation professionals who most often deliver services in this model are vocational rehabilitation counselors, vision rehabilitation therapists, and orientation and mobility specialists. The medical rehabilitation model delivers rehabilitation services through the medical system and has a primary focus of improving the functional performance and quality of life of children, adults, and older adults with vision impairments. The practitioners who mainly deliver services in this model are ophthalmologists, optometrists, low vision therapists, occupational therapists, social workers, and psychologists. These models can be compared using several factors: (1) funding of services; (2) the location where services are provided; (3) practitioners that deliver services; and (4) the services that are provided by each practitioner (see Appendix 2).

Funding

Low vision rehabilitation services offered through the medical rehabilitation model are funded by private health insurance, and/or Medicare or Medicaid (Owsley et al., 2009; Berger, 2013; Mogk & Goodrich, 2004). In contrast, low vision rehabilitation services through the education model are funded by state and federal monies allocated to state vocational rehabilitation agencies that disburse funds to non-profit agencies and private contractors who provide services to clients with visual impairments. Besides obtaining some funding from state vocational rehabilitation agencies, non-profit agencies that serve clients with visual impairments can also receive monies from fundraising activities, charitable donations, and grants. Another important difference in funding between the two low vision rehabilitation service delivery models is that funding through the medical rehabilitation model covers all ages, whereas funding through the educational model is limited for children from 1 – 16 years old and adults aged 55 and older, because state vocational agencies give priority to clients who are of working age (Mogk & Goodrich, 2004).

Location

Low vision rehabilitation services through the medical rehabilitation model focus more on clinic and home-based services which is reflected in the locations where services are commonly delivered, like private ophthalmology or optometry offices, hospitals, outpatient clinics, the client's home through a home healthcare agency, and comprehensive outpatient rehabilitation facilities (Owsley et al., 2009; Berger, 2013; Mogk & Goodrich, 2004). On the other hand, low vision rehabilitation services through the education model focus on community and home-based services, such as non-profit agency clinics, the client's home through itinerate services provided by a non-profit agency, community (e.g., grocery store, restaurant, pharmacy, etc.), and client workplaces.

Practitioners and the Services They Provide

The only practitioners in the medical rehabilitation model that do not have a counterpart that provides similar services in the education model are ophthalmologists and optometrists (Owsley et al., 2009; Mogk & Goodrich, 2004). Although ophthalmologists are the only practitioners who evaluate and treat eye disease, both ophthalmologists and optometrists perform ocular examinations, assess visual function, prescribe optical devices, and recommend non-optical devices. In some cases, optometrists provide training in the use of optical and non-optical devices, whereas ophthalmologists do not. Conversely, practitioners in the education model who do not have a counterpart that provides similar services in the medical rehabilitation model are orientation and mobility specialists. These practitioners perform functional vision assessments, and assess and provide training in safe mobility around the home and community, including the use of support and long canes as well as sunglasses for glare, and monoculars for orientation and spotting.

Occupational therapists, in the medical model, perform two services that overlap with orientation and mobility specialists, in the education model – (1) driving evaluation and rehabilitation, and (2) introducing clients and their families to local and national resources and services (Owsley et al., 2009; Mogk & Goodrich, 2004). The low vision therapist and occupational therapist in the medical rehabilitation model perform similar services, such as training in the use of optical aids and other non-optical devices during activities of daily living; training in adaptive skills for performing everyday activities; training in eccentric viewing; training in computer and accessible technology, including enlargement and speech output; introducing clients to local and national resources and services; and training and support for caregivers. Vision rehabilitation therapists in the education model perform the same services as low vision therapists and occupational therapists, except for training in eccentric viewing. In addition to these services, occupational therapists in the medical rehabilitation model and vision rehabilitation therapists in the education model also engage in driving evaluation and rehabilitation; assessment and adaptation of home environment; vocational training; and training in recreational activities. Psychologists and social workers in the medical rehabilitation model perform the same services as the vocational rehabilitation counselor in the education model, including counseling services; emotional and psychological adjustment to disability; emotional and psychological support for caregivers; and introduction to local and national resources and services. In addition to these services, however, vocational rehabilitation counselors also provide case management services, and vocational counseling and training.

Even though differences exist between the two low vision rehabilitation service delivery models (i.e., funding, location of service provision, practitioners, and services provided by the various practitioners), Owsley et al. (2009) emphasize that the goal of low vision rehabilitation - to help clients effectively utilize their remaining vision to accomplish activities of daily living which, in turn, improves their quality of life – should be the focus of services rather than the delivery model, funding, location, practitioner, or services offered by the practitioner. In fact, no clinical trials have been conducted to determine which if any of these factors of service delivery is most effective (Owsley et al., 2009). Instead, studies have focused on the outcomes of low vision rehabilitation services, namely, assessing clients' needs for low vision rehabilitation services, performing an eye and visual function evaluation, prescribing and training in the use of optical and non-optical devices, and teaching clients adaptive skills for performing everyday activities.

Effectiveness of Low Vision Rehabilitation Services

Low vision rehabilitation services are necessary for some people with vision impairments to overcome the functional challenges that result from vision loss. These services range from helping people with vision impairments adapt their environment to teaching compensatory skills in order to improve people with vision impairments ability to perform their everyday living tasks. These adaptations and compensatory strategies often include incorporating some form of technology, either off-the-shelf technology or specialized assistive technology. This section addresses the effectiveness these various low vision rehabilitation services have in helping people with vision impairments be as independent as possible. The section will also examine the limitations or barriers associated with traditional in-person low vision rehabilitation services. Finally, telerehabilitation is introduced as a solution that can potentially overcome these barriers. Telerehabilitation has been effectively implemented in various rehabilitation settings with various populations, but little evidence supports the use of telerehabilitation in the area of low vision rehabilitation. This study seeks to address some of the gaps in the literature related to using telerehabilitation as a low vision rehabilitation service delivery option.

Walter et al. (2007) utilized a retrospective survey design to ascertain participants' perceived effectiveness of low vision rehabilitation. A total of 417 people responded to the survey, and of these participants only 105 reported receiving low vision rehabilitation services. Each participant answered a 20-question survey containing items that asked respondents to rate their level of difficulty with performing certain activities of daily living on a scale of 1 to 7 (1 = no difficulty; 2 = a little difficulty; 3 = moderate difficulty; 4 = extreme difficulty; 5 = stopped doing this because of your eyesight; 6 = stopped doing this for other reasons/not interested; 7 = don't know). Respondents were also asked to recall their difficulty with these activities before they received rehabilitation, and if they received rehabilitation, and how they perceived their vision after rehabilitation. If respondents reported receiving vision rehabilitation, they were asked to answer the same 20 questions regarding their functional performance prior to participating in vision rehabilitation. Subjects' answers to the 20 questions before and after vision rehabilitation were compared using a paired samples t-test. The researchers discovered that for the 11 near vision task questions (e.g., reading ordinary print in newspapers, playing cards or games, finding something on a crowded shelf, and shaving/styling hair/putting on make-up) respondents reported experiencing an improvement in all tasks, but only 9 tasks were noted to have a statistically significant improvement. For the three distance vision task questions (e.g., reading street signs or the name of stores, recognize people you know from across the room, and seeing and enjoying programs on television), respondents were noted to report statistically significant improvements with all three tasks. Lastly, for the seven vision-related social activities questions (e.g., conducting normal social activities, entertaining friends and family in your home, and going out to see movies/plays/sports events), respondents experienced an improvement in all tasks with statistically significant improvements found for only 2 of the tasks. The authors mention that the lack of improvement with vision-related social activities may be due to the mean age of the sample (i.e., 70.8 years), and/or the fact that vision rehabilitation, unlike mental health rehabilitation, does not place a lot of emphasis on improving social activities.

Pearce, Crossland, and Rubin (2011) studied the effect of low vision device training on the functional performance and quality of life of people with low vision using a repeated measures matched between subjects quasi-experimental design. The study had a total of 96 subjects that completed the study and were evenly distributed into either a control group (participants that only attended the initial low vision assessment), or intervention group (participants that attended the initial low vision assessment and an additional visit with a low vision support worker). Participants in the control and intervention group were matched according to age, gender, and visual acuity. The study required subjects to attend an initial low vision assessment where data was collected on visual acuity, performance of activities of daily living, and quality of life. Those who were randomized into the intervention group attended a follow-up visit with a low vision support worker who reviewed handling of low vision devices, discussed specific problems noted at home, issued new devices or exchanged them for something more appropriate when necessary, and made sure participants were aware of all services available to them through local social services and volunteer organizations. After this follow-up appointment, functional performance and quality of life data were collected for participants in each group at one and three months after the initial low vision assessment. The study found that the initial low vision assessment resulted in participants' improvement in functional performance of daily living tasks, and that the additional visit with a low vision support worker by participants in the intervention group did not further improve this group's functional performance. The researchers noted that the lack of additional improvement in the intervention group's functional performance may be due to several factors: (1) the initial low vision assessment only involved prescribing and dispensing simple optical devices, like hand magnifiers, stand magnifiers, and spectacle mounted telescopes, rather than more advanced electronic magnifiers and non-optical devices; therefore, the follow up visit with a low vision support worker to review the handling and use of these more rudimentary devices was not needed for the majority of the participants; (2) neither the initial visit nor the follow up visit with the low vision support worker involved more intensive vision rehabilitation services, like eccentric viewing techniques, and compensatory skills training; and (3) the services provided to participants were not multidisciplinary and did not include multiple visits which may prove to be more beneficial in providing more intensive vision rehabilitation services.

Ganesh et al. (2013) utilized a quasi-experimental pre- post- test design to determine if prescription and training in the use of optical and non-optical devices would improve visual functioning. Participants consisted of 35 visually impaired students with no other physical or mental impairments between the ages of 6 and 16. Prior to the prescription, dispensing, and training in the use of optical and non-optical aids, participants completed the following: (1) a complete ophthalmic history and examination that included unaided distant and near visual acuity (line acuity), color vision, contrast sensitivity, visual fields, and visual electrophysiology; (2) orally administered a self-report questionnaire of visual functioning; and (3) a counseling session with the subjects' parents to evaluate the visual needs of the child, explain the subjects' visual impairment, and discuss the pros and cons of optical and non-optical device use. The intervention consisted of prescribing, dispensing, and training in the use of optical and non-optical devices that included telescopes, lamps and reading stands, writing guides, bold-lined notebooks, and large print books. Post-test results detected a significant improvement in both near visual acuity ($p = .001$) and far visual acuity ($p< 0.0001$). The researchers also found statistically significant improvements with other visual tasks, such as copying from the blackboard ($p < 0.0001$), reading textbooks at arm's length ($p < 0.0001$), writing along a straight line ($p = 0.003$), applying toothpaste to a toothbrush ($p = 0.001$), and identifying someone from across the road ($p = 0.001$).

Liu et al. (2013) performed a systematic review to investigate the effectiveness of occupational therapy interventions on older adults with low vision. Seventeen studies met the researchers' established inclusion/exclusion criteria and described three intervention approaches based on either the number of components (i.e., single-component or multicomponent), or the number of disciplines included in the intervention (i.e., multidisciplinary). Single-component interventions solely focused on one aspect of low vision, such as training in the use of optical and non-optical devices, lighting, and eccentric viewing. Multicomponent interventions consisted of multiple components (e.g., teaching about low vision, training in the use of optical and non-optical devices, teaching of relaxation skills, training in problem solving skills, and providing low vision information and resources) that address different features of low vision. Multidisciplinary interventions involve the use of one or more team members, including caregivers, to provide services to clients with visual impairments. The results of this systematic review provide strong evidence to support the claim that the services provided are more important in improving clients' independence in activities of daily living than how the services are provided, or what professional provides the services. Some studies revealed that a multicomponent intervention approach or a single component intervention approach over several sessions had significant positive outcomes related to clients' performance of both basic and instrumental activities of daily living; other studies reported that a multidisciplinary intervention approach that was tailored to address the clients' goals improved the functional independence of older adults' with low vision at home more than interventions that were not personalized to fit clients' goals.

Goldstein et al. (2015) performed a prospective observational study to determine the effectiveness of outpatient low vision rehabilitation services over a three-year period. A total of 468 patients - of the 779 patients that were recruited - from 28 outpatient low vision rehabilitation clinics in the United States completed the study. Several pre- and post-test rehabilitation assessments (i.e., Activity Inventory, Geriatric Depression Scale, Telephone Interview for Cognitive Status, and Medical Outcomes Study 36-Item Short-Form Health Survey) were used to measure participants overall visual ability as well as their reading, mobility, visual motor function, and visual information processing abilities. The researchers found that outpatient low vision rehabilitation services had a large average effect size, or a Cohen's d = 0.87, for improvements of overall visual ability in 47% of the patients. Moderate effect sizes were noted with improvements in the four specific areas as a result of outpatient low vision rehabilitation services: (a) 44% of patients improved with reading with a Cohen's d = 0.45; (b) 38% improved with visual motor function with a Cohen's d = 0.54; (c) 33% of patients improved with visual information processing with a Cohen's d = 0.42; and (d) 27% of patients improved with mobility with a Cohen's d = 0.50. Lastly, a regression analysis found no strong consistent predictors of low vision rehabilitation outcome results which indicates that the improvements in overall visual ability, reading, visual motor function, visual information processing, and mobility were a direct result of low vision rehabilitation training.

These articles help to reiterate the point that what low vision rehabilitation has to offer clients with vision impairments (i.e. improvement in functional performance of daily living activities and quality of life) is more important than where services are delivered, how services are paid for, and what professional delivers the services. Kaminsky et. al. (2014) adapted the Person Environment Occupation Performance (PEOP) model to relate the concepts more specifically to the visually impaired population. Specifically, this model adaptation emphasizes the relationship that exists between the functional performance of people with vision impairments and their ability level, environment, and task(s) they are performing. They state that people with vision impairments ability to independently and successfully complete a task relies on the interaction between their innate abilities (e.g., visual functioning, cognition, and sensation), environment (e.g., physical and social), and activity (e.g., cooking, dressing, working, bathing, and taking care of others). A relationship where all three factors are equally balanced describes successful and independent functional performance, whereas an imbalanced relationship between any of the three factors depicts diminished or impaired functional performance. Unfortunately, people with vision impairments often experience impaired functional performance due to the demands of the activity, and possibly even the environment, requiring more functional vision abilities (e.g., visual acuity, depth perception, and contrast sensitivity) than they have available. These people with impaired functional performance can learn through low vision rehabilitation services how to use other innate abilities, environmental features and adaptations, and compensatory techniques and skills to balance out the demands of the activity. This, in turn, will allow successful and independent performance of the activity.

Currently, low vision rehabilitation services are delivered in-person in a variety of environments, such as the client's home and/or work, outpatient clinic, or agency, and consist of an assessment phase that is subdivided into four steps (i.e., the intake, assessment of residual visual functions, assessment of residual functional vision, and prescribing for low vision rehabilitation), and an intervention phase that is subdivided into two steps (i.e., dispensing for low vision rehabilitation, and vision rehabilitation therapy for improvement of residual skills) (Markowitz, 2006; Markowitz, 2016; Ryan, 2014). Figure 1 provides a visual representation of the six stages of low vision rehabilitation services that are detailed below.

- **intake:** The intake begins with a review of the client's prior medical and surgical history followed by a brief ocular examination to ensure the accuracy of the collected information as well as ensure all treatable ocular conditions that may be causing the visual impairment have been addressed. If a treatable ocular condition is discovered then the issue should be resolved before continuing with the low vision assessment, since the results could possibly reveal that low vision rehabilitation is no longer needed. The client's cognitive skills are then evaluated to determine if the client will be able to understand and follow instructions when learning how to use optical and non-optical devices, and compensatory strategies and skills. The next part of the intake requires the identification of client's goals and residual functional vision skills through the use of questionnaires (e.g., National Eye Institute 25-item Visual Function Questionnaire) that inquire about performance of activities of daily living.
- **assessment of residual visual functions:** This step is utilized to measure, evaluate, and accurately document the degree of functional loss the client has sustained from the disease/condition. Specifically, this step evaluates the client's refractive errors (i.e., myopia, hyperopia, and astigmatism), visual acuity (i.e., near and distant acuity), perimetry (i.e., central and peripheral visual field), oculomotor functions (i.e., efficient movement of eyes during fixation, pursuits, and saccades), cortical visual integration (i.e., identification of objects by sight,

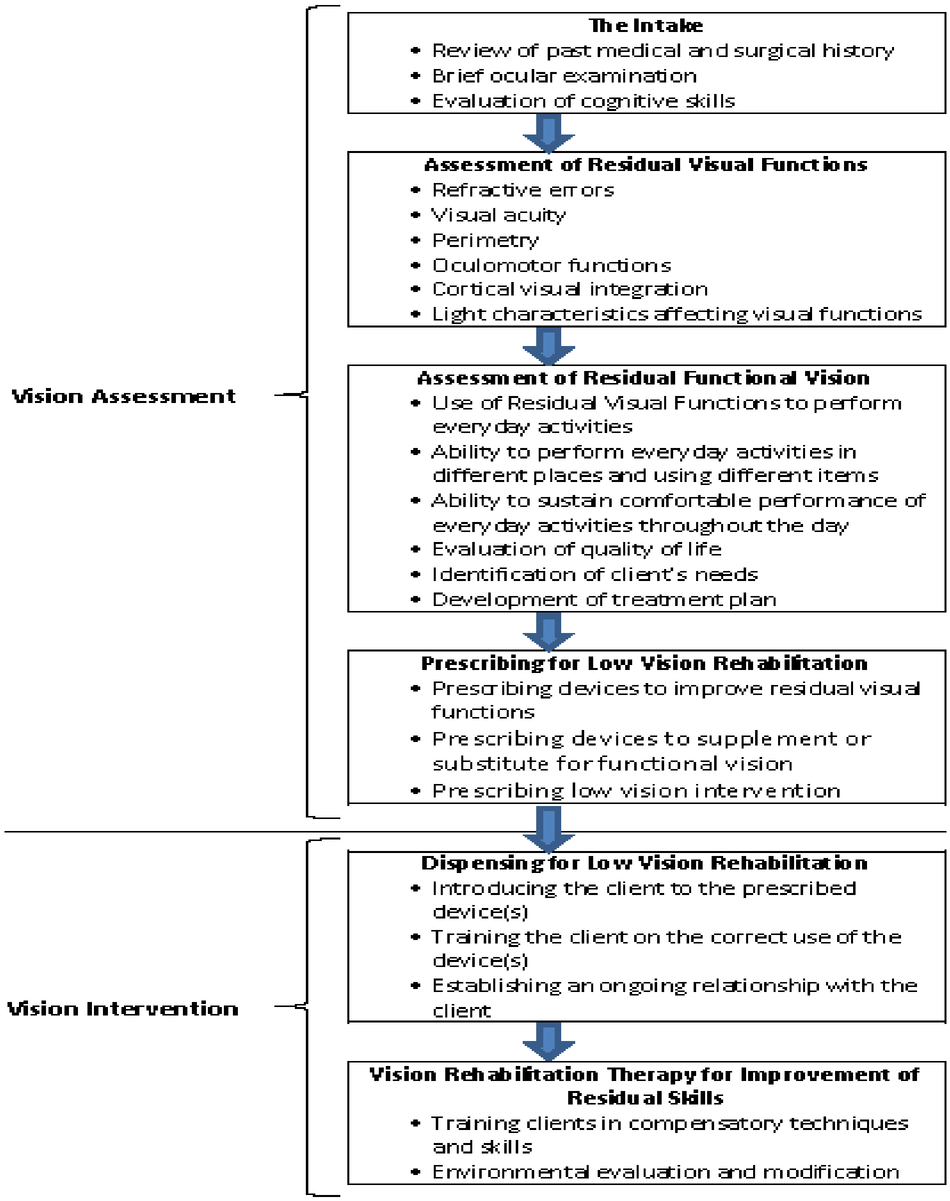
recognition of faces, and detection of colors), and light characteristics affecting visual functions (i.e., glare and contrast sensitivity).

- **assessment of residual functional vision:** This step is used to determine how well a client utilizes his vision and what visual skills need further development. Basically, this evaluation assesses how a client performs everyday living tasks in different places, using different items, and measures the extent to which a client effectively uses his residual visual functions to perform everyday living tasks in different places, using different items, and if the client can sustain comfortable performance throughout the day. This portion of the assessment also includes measurement of vision-related quality of life, perception, and interpretation of other sensory stimuli (e.g., proprioception, kinesthesia, touch, hearing, etc.), and impact of vision loss on the skills assessed. The client's needs related to near and intermediate distance vision tasks, optical devices, non-optical devices, orientation and mobility, and driving are also identified during this step. After this information is compiled a rehabilitation plan is created in consultation with the client to guide "instruction in the use of residual visual skills for everyday living tasks, instruction in the use of visual environmental cues, modification of the visual environment to enhance the use of vision, and the use of appropriate psychosocial information to devise motivational strategies to assist in performing desired tasks" (Markowitz, 2006, p. 300).
- **prescribing for low vision rehabilitation:** This step first focuses on improving the client's vision abilities, such as visual acuity, contrast sensitivity, visual fields, and oculomotor skills, which, as a result, will improve the client's ability to

perform daily living tasks. This is achieved by prescribing devices that will correct refractive errors, provide occlusion therapy, enhance oculomotor skills, manipulate light, magnify objects and text, and correct for visual field loss. The next focus of this step is to prescribe devices to supplement or substitute for functional vision. This is accomplished through the use of adaptive computer hardware and software to translate visual stimuli to auditory and/or tactile input as well as to translate sound to written text. The last focus of this step is to prescribe low vision intervention where the client will receive training in the use of prescribed optical and non-optical devices, training in compensatory and adaptive techniques and skills to assist the client in efficiently and independently performing daily living tasks, and adapting and modifying the client's environment to accommodate the client's functional vision.

- **dispensing for low vision rehabilitation:** This step consists of introducing the client to the prescribed optical and non-optical devices, training the client in how to correctly use the device, and establishing an ongoing relationship with the client.
- **vision rehabilitation therapy for improvement of residual skills:** This step focuses on training clients in compensatory techniques and skills to address deficits in visual skills (e.g., fixation stability, saccades, tracking, and scotoma awareness), reading and writing, activities of daily living, orientation and mobility, and driving. Another focus of this step is conducting an environmental evaluation of the client's home and/or workplace (e.g., lighting, contrast, and safety), and

Figure 1: Stage of Low Vision Rehabilitation Services



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implementing adaptive strategies to improve the client's functioning within these environments.

Barriers to the Acceptance and Use of Low Vision Rehabilitation Services

Despite the variety of low vision rehabilitation service delivery options for people with vision impairments and the strong evidence that supports the effectiveness and positive outcomes of low vision rehabilitation, the one problem that remains is the access and utilization of low vision rehabilitation services by people with vision impairments. In fact, Matti et al. (2011) state that a "clear mismatch [exists] between the need and the uptake of low-vision services" (p. 181). For instance, in Australia, less than one in five clients with low vision access low vision rehabilitation services (Pollard et al., 2003). A literature review conducted by Lam and Leat (2013) found that the "rate and awareness of low vision services continues to be low, ranging from 29% to 75%" (p. 458).

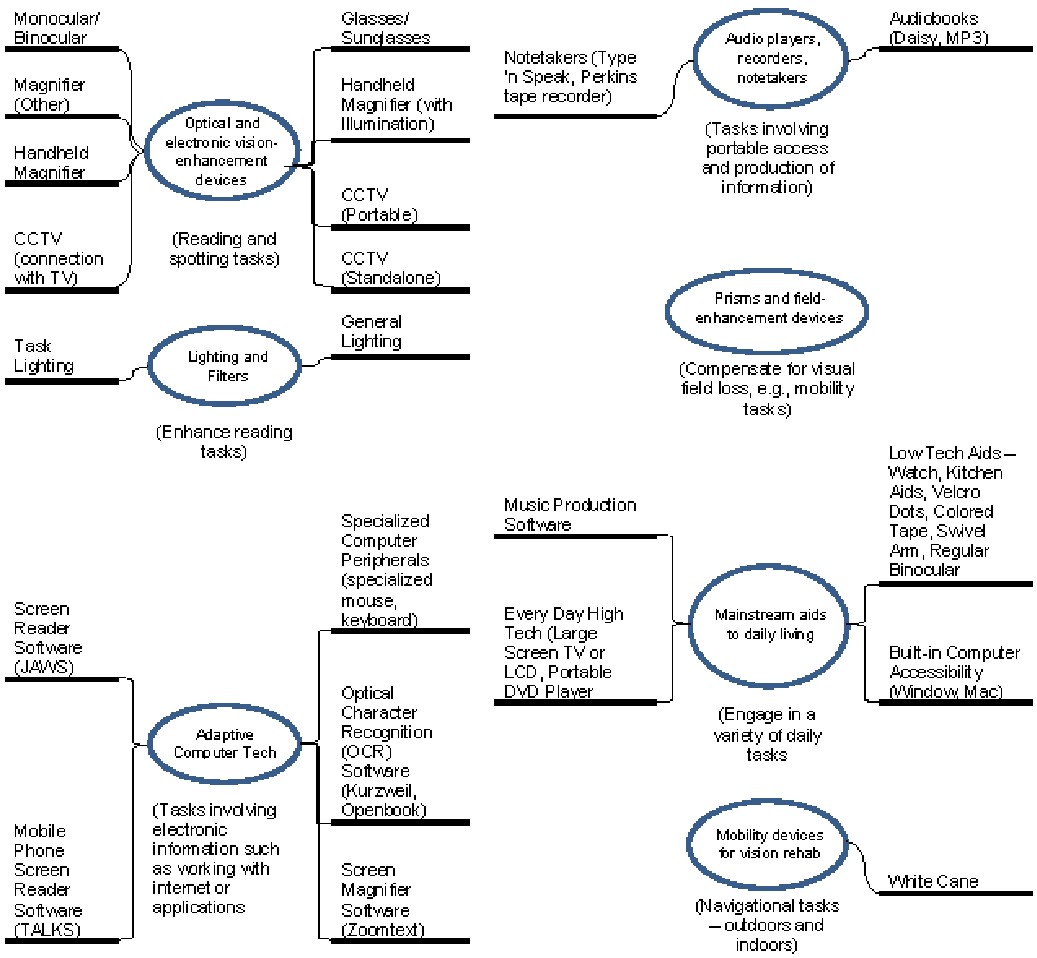
More recently, Markowitz (2016) reported that approximately 20% to 30% of people in developed countries, and 10% to 15% of people in developing countries, who need low vision rehabilitation actually received low vision services. The barriers to access and utilization of low vision rehabilitation services have been identified at all levels of care: (1) system of low vision rehabilitation delivery; (2) process of low vision rehabilitation; and (3) clients with vision impairments (Matti et al., 2011). The barriers related to the system of low vision rehabilitation delivery include limited availability of low vision services, lack of training in low vision services, and unequal distribution of low vision services between urban and rural areas (Chang et. al., 2012;Khan, Shamanna, & Nuthethi, 2005; Okoye et al., 2007; Nia, & Markowitz, 2007). Barriers that have been identified in the process of low vision rehabilitation are lack of awareness and referral for low vision services by ophthalmologists and optometrists, lack of information about low vision rehabilitation services being distributed to clients, and a need for better cooperation and referral between low vision rehabilitation service providers (Adam & Pickering, 2007; Nia, & Markowitz, 2007; Overbury, & Wittich, 2011). Patient-related barriers consist of a lack of understanding of the long term consequences of vision impairments, presence of concurrent health problems, difficulty obtaining transportation to and from low vision rehabilitation appointments, need for someone to accompany clients to the low vision rehabilitation appointment, and perception that low vision rehabilitation services are not required or would not be helpful (O'Connor, Mu, & Keeffe, 2008; Overbury, & Wittich, 2011; Southall, & Wittich, 2012). Unless the majority of these barriers are addressed, people with vision impairments will continue to have a poor rate of low vision rehabilitation service utilization and access which means that blindness and vision impairments will remain a major public health problem that negatively affects both individuals and society.

Technology and Vision Impairments

The creation and use of optical and non-optical technology, or low vision assistive technology devices) to help people with vision impairments is one of three critical developments in low vision rehabilitation (Mogk and Goodrich, 2004). In fact, the importance low vision assistive technology devices play in the low vision rehabilitation process has been highlighted in each of the above-mentioned articles that addressed the effectiveness and benefits of low vision rehabilitation services (i.e., Ganesh et al., 2013; Liu et al., 2013; Pearce, Crossland, & Rubin, 2011; Walter et al., 2007). These previously mentioned studies as well as others (i.e., Morse et al., 2010; Jutai, Strong, & Russell-Minda, 2009; Fok et al., 2011) discuss the use of optical and non-optical devices as being critical and inseparable from the other services provided during the low vision rehabilitation process in helping people with vision impairments improve their functional independence and quality of life.

The first optical device - a telescopic lens by Zeiss Optical – was invented in 1918 followed by the development of the first electronic non-optical device - a closed-circuit television by Rand Corporation - in 1964 (Mogk & Goodrich, 2004). Since these first developments, numerous devices have been developed (see figure 2) that possess similar functions, but have slight differences in functional attributes that “vary in usefulness from person to person” (Jutai, Strong, & Russell-Minda, 2009, p. 220). Kaldenberg and Smallfield (2016) performed a repeated measures (i.e., pretest, posttest, and 3-month follow-up) small N study where four participants with vision impairments attended 10 training sessions where they were taught and trained on how to use a computer tablet as a low vision assistive technology device for completing everyday living tasks. This study was noted to have three important findings: (1) participants demonstrated an improvement in functional performance between pretest and posttest; (2) subjects reported an increased satisfaction with performance of daily living tasks; and (3) participants were found to use the tablets significantly more between pretest and posttest, and this increased tablet use was maintained at the 3-month follow-up. In addition to these findings, the authors also concluded that subjects reported using the computer tablets for significantly different purposes; some used the

Figure 2: Low Vision Assistive Technology Devices Categorized by Type and Area of Function Addressed



Note: Reprinted with permission from Fok et al. (2011) (See Appendix 3) tablet primarily for social communication, and others incorporated the tablet into their daily routines.

Crossland, Silva, and Macedo (2014) surveyed 132 participants with vision impairments to determine their use of smartphone, tablet, and e-reader technology devices. The majority (> 80%) of the subjects who used smartphones reported using them for typical purposes, such as talking, texting, and searching the internet, and more than half of these participants used the camera and screen as a magnifier. All of the subjects who used a tablet computer indicated using the device to search the internet, and over half of these respondents reported using the device for audiobooks and the camera and screen as a magnifier. A small portion of the sample (17%) used an e-reader device for reading or listening to books and accessing the internet. This study revealed that smartphones, tablets, and e-readers are being used by people with a variety of vision impairments. These people utilized the devices for their text-to-speech and text enlargement capabilities, and more than half of the sample were noted to use the camera and screen as a magnifier and the camera flash as a spotlight.

Fok et al. (2011) conducted a semi-structured telephone interview with 17 subjects with low vision to identify the low vision assistive technology devices currently being used by this population, and to investigate the participants’ perceptions on the devices’ relative importance for the performance of daily activities. Participants identified a total of 124 devices, and, out of this total number, participants indicated using 104 (83.9%) devices and not using 20 (16.1%) devices which consisted predominantly of adaptive computer technologies. Twenty-two devices (21%) of the total devices consisted of mainstream technologies, such as large monitor, large screen television, and DVD player that participants ranked high in perceived importance. The researchers also found that each participant, on average, currently used 6.1 assistive technology devices with a range of 3 to 14 devices. Overall, this study revealed that low vision assistive technology usage and ranking of importance for performance of daily activities is multifaceted, complex (e.g. how many devices are used by each participant, how participants ranked the devices' importance, etc.), and unique to the individual.

One concept mentioned by Crossland, Silva, and Macedo (2014) and Fok et al. (2011) was the abandonment, or nonuse, of low vision assistive technology devices. Crossland, Silva, and Macedo (2014) found that nonuse was typically due to cost and lack of interest.

Fok et al. (2011) reported that participants primarily abandoned specialized adaptive computer technologies due to computer incompatibilities with the technology. This concept of low vision device abandonment was specifically investigated by Dougherty et al. (2011) through the use of a telephone survey administered 1 year after examination and prescription of devices to 88 participants with vision impairments from four clinical sites. The survey inquired about subjects' timing and frequency of use and reasons for abandonment of devices. Like Fok et al. (2011), Dougherty et al. (2011) found that only a small percentage of the sample abandoned their low vision assistive technology devices (19%). The results also revealed that abandonment of low vision assistive technology devices was not correlated with age, time since prescription, visual acuity, or category of magnification device (e.g., spectacle, handheld, stand, or video), instead abandonment of magnification devices was most closely associated with noncentral visual field loss. These issues of low vision assistive technology device abandonment, or nonuse, (i.e., cost, lack of interest, and peripheral vision field loss) are important to consider when exploring the possibility of using telerehabilitation technology as a service delivery option in low vision rehabilitation.

Gobeille et al. (2018) also investigated the utilization and abandonment of low vision assistive technology that were prescribed through a mobile clinic. The purpose of this new low vision rehabilitation service delivery model was to provide recommendations for training, follow-up recommendations, and assistive technology devices, including glasses. A total of 65 participants with a mean age of 72.5 years were recruited to participate in this study – 59 participants were deemed legally blind. The main purpose of the study was to measure low vision assistive technology device abandonment by administering a device abandonment questionnaire over the telephone 3-months and 1-year post-rehabilitation. Secondary measures assessed by the study were assistive technology device non-receipt, utilization, and frequency of use. A total of 154 low vision assistive technology devices were recommended to participants during the study with an average of 2.6 assistive technology devices being recommended per participant. The most common low vision assistive technology devices that were recommended included digital magnification, optical magnifiers, and filters. At 3 months post-rehabilitation, a total of 14% (n = 21) of all recommended low vision assistive technology devices were abandoned with 29% of study participants abandoning 1 or more low vision assistive technology devices. The low vision assistive technology devices that were used on a day-to-day basis by participants were recommended to address reading tasks whereas the devices that were most frequently abandoned by participants were recommended for distance magnification and glare control. After 1 year post-rehabilitation, a total of 18% (n = 15) of all low vision assistive technology devices were abandoned. The most commonly abandoned low vision assistive technology devices were recommended for distance magnification (i.e., telescopes) while the low vision assistive technology devices that were most commonly used on a daily basis were recommended for reading, such as digital magnification devices and hand magnifiers. The researchers found no difference between the number of low vision assistive technology devices abandoned at 3 months and 1 year ($t = .82$, $p = .23$) as well as the number of low vision assistive technology devices used at 3 months and 1 year ($t = .38$, $p = .89$). Through the use of a multiple linear regression the authors were not able to identify any variables (i.e., age, visual acuity, central vision loss, peripheral vision loss, contrast sensitivity, number of systemic comorbidities, overall Activity Inventory change score, and prior low vision rehabilitation experience) that were significantly predictive of low vision assistive technology device abandonment. These results were found to be consistent with the results of the previous study (i.e., Dougherty et al., 2011), and have provided additional reasons for abandonment of low vision assistive technology devices, such as cost of devices, payment source for devices, and accessibility to low vision rehabilitation services). One reason for the most commonly abandoned low vision assistive technology devices that were recommended for distance vision tasks and glare control that supports the use of telerehabilitation is the limited ability of the researchers to evaluate and train participants in the use of these devices in their natural environments.

Summary of the Population and The Population's Use of Services and Technology

The needs or problems that were identified consists of the impact vision impairments have on (1) the individual in the form of decreased performance of everyday activities, social isolation, quality of life, and depression; (2) the family and caregivers through the increased burden of caring for the individual with a vision impairment who has lost their independence; and (3) society through the increase in direct and indirect costs required to care for an individual with a vision impairment. Previous practice used to increase an individual's independence which, in turn, will decrease the burden on family, caregivers, and society is low vision rehabilitation services. Currently, low vision rehabilitation services are delivered through one of two models (i.e., medical rehabilitation model, and education model) that utilize different professionals that perform similar functions. Evidence suggests that low vision rehabilitation services are effective in improving functional performance as well as quality of life, regardless of the model, funding, or professional used. This evidence also points out that the major decision makers in the low vision rehabilitation process are the client and the low vision rehabilitation professional that, for the purpose of this project, make up two of the three primary groups of the target population. Despite the barriers that impede the access and use of low vision rehabilitation services by people with vision impairments, the target population, as a whole, appears to be innovative by nature. They use more than 100 different technology devices to accomplish daily living tasks successfully and independently. The target population has also leveraged mainstream technology (i.e., tablets, smart phones, e-readers, etc.) to improve residual functional vision. Thus, the use of technology for most of the target population is essential to everyday life, and, as a result, has been integrated into their beliefs, values, norms, and behaviors.

Telehealth and Telerehabilitation

As mentioned above, most people in the target population consider technology essential in their everyday lives and are comfortable with using a variety of technology devices, including mainstream computer-based technology. In fact, many utilize mainstream computer-based technology for socialization purposes which can include talking with friends and family via text messaging, smart phone, or video-based software applications (e.g., Skype); and communicating with friends, family, and other people through email and social media (e.g., Facebook). These technologies are similar to the technology used for telehealth, which is defined as the "use of electronic communications and information technology to deliver health-related services at a distance" (Cason & Brannon, 2011, p. 15). Up until recently many people with vision impairments or people who work with them (i.e., eye care and vision rehabilitation professionals) have not used mainstream computer-based technology for health-related purposes, but many of them were aware and familiar with similar technology used to communicate and interact with people at a distance, such as Facetime and Skype. However, starting in 2019 there has been a significant increase in the awareness and use of telehealth and telerehabilitation among healthcare professionals and patients due to the social distancing requirements put in place to reduce the transmission of the novel coronavirus (COVID-19) (Andrews et al., 2020; Thomas et al., 2020). Andrews et al. (2020) performed an integrative literature review to determine if healthcare professionals and patients were satisfied with the use of telehealth and telerehabilitation, since its unparalleled rise in use occurred. They found that most healthcare professionals and patients had a high level of satisfaction with the use of telehealth and telerehabilitation during the coronavirus pandemic, and they also reported a willingness to continue to use the telehealth and telerehabilitation after the pandemic.

Telehealth is utilized in various areas of healthcare, such as gap service coverage (e.g., teleradiology coverage), urgent care services (e.g., telestroke, teletrauma, and teleburn services), mandated services (e.g., correctional telemedicine, or the delivery of healthcare services to prison inmates), and the increase of video-enabled multisite group chart rounds (e.g., Extension for Community Healthcare Outcomes programs) (Weinstein et al., 2014). A review of the telehealth literature found strong evidence touting the benefits of telehealth (Moffatt & Eley, 2010). The client-related benefits of telehealth consisted of decreased inconvenience while accessing specialty health services, increased access to healthcare services, and reduced out-of-pocket expenses. The system-related benefits of telehealth included reduced costs of service delivery; increased quality of clinical services; and improved opportunities for clinician education, development, and mentoring. The literature even pointed to improved process-related benefits through enriched local services, and greater inter- and intra-professional communication, collaboration, and consultation. Many of these telehealth benefits are direct answers to the barriers encountered in accessing and utilizing low vision rehabilitation services.

The application of telehealth – the use of telecommunication and information technologies – to deliver rehabilitation services is called telerehabilitation (Russell, 2007). Specifically, telerehabilitation is defined as “the application of evaluative, consultative, preventative, and therapeutic services delivered through telecommunication and information technologies” (AOTA, 2013, p. S69). Telerehabilitation, as a rehabilitation service delivery option, can be synchronous (i.e., delivered in real time via interactive technologies), or asynchronous (i.e., delivered at a different time than the activity being performed via store-and-forward technologies), or have characteristics of both (see Table 1 for examples). Regardless of how telerehabilitation is delivered – synchronous or asynchronous, telerehabilitation provides a mechanism for rehabilitation professionals to deliver services at a location that is physically distant from the client, so services can take place where clients live, work, and play. Research has demonstrated that both phases of the rehabilitation process can be administered over long distances with the use of telecommunication and information technologies, instead of requiring the client and rehabilitation professional to be in the same room.

Table 1: Summary of Types of Telerehabilitation Technology, Delivery Options, and Advantages and Disadvanges

Type of Telerehabilitation Technology	Delivery Options	Characteristics of Delivery Option	Advantages / Disadvantages
Synchronous Technologies	Voice over the Internet Protocol (VoIP)	• Mechanism for internet-based audio or video conferencing • Requires a computer, special VoIP phone, or traditional phone with an adapter to convert voice into a digital signal that travels over the internet • Can be integrated with video software to allow for videoconferencing	***Advantages*** • Services are delivered in the clients' own environments (e.g., home, work, community, etc.) • Has minimal infrastructure requirements • Lower costs for equipment and connectivity (e.g., residential service plan, data plan ***Disadvantages*** • Privacy, security, and confidentiality risks • Lack of infrastructure (e.g., limited access to high-speed Internet / broadband; inadequate bandwidth for connectivity) • Recurring expense (e.g., residential service plan, data plan) • Diminished sound or image quality • Technological challenges associated with the end-user experience, and expertise with video conferencing technology
	Mobile video conferencing systems	• Mechanism for audio or video conferencing • Requires a mobile device (e.g., smartphone, electronic tablet), videoconferencing capabilities (e.g., app, camera), wireless or cellular network	
	"plain old telephone service" (POTS)	• Mechanism for audio or video conferencing • *For audio conferencing*: Requires an analog telephone line, or landline to support audio • *For video conferencing*: Requires an analog telephone line or landline to support audio and video transmission, a videophone or specialized equipment connected to a television	
	High-definition Television (HDTV) technologies	• Mechanism for video conferencing • Requires a HD television, console, HD camera, remote control, and high-speed broadband connection at both locations	
	Telehealth networks	• Mechanism for video conferencing • Requires high-end videoconferencing technologies (e.g., Polycom, Tandberg), fiber-optic telephone lines (e.g., T1 lines), or high-speed Internet to connect sites	
Asynchronous Technologies	Video clips	• Requires a video camera, mobile device (e.g., mobile phone, tablet, etc.) with video	***Advantages***

Type of Telerehabilitation Technology	Delivery Options	Characteristics of Delivery Option	Advantages / Disadvantages
		recording capabilities, or a laptop or desktop with a camera and video software	• Client information is stored for future reference and documentation
	Digital photographs	• Requires a camera, video camera that can take still pictures, mobile device (e.g., mobile phone, tablet, etc.) with a camera, or a laptop or desktop with a camera and photo software	***Disadvantages*** • Client and rehabilitation professional do not have real time interaction • Confidentiality (security of data, privacy) • Provider and clients comfort, experience, and expertise with technology • Equipment accessibility • Image quality
	Virtual technologies	• The use of interactive simulations generated with computer hardware and software that present users with opportunities to participate in environments that appear and feel similar to real-world objects and events • Typical use of VR technologies does not constitute a telehealth service • VR is considered a telerehabilitation service delivery option when it is used to monitor and adjust interventions with clients	
	Other forms of electronic communi-cations	• Electronic mail • Social media • Text messaging • Instant messaging	
Combined Technologies	Tele-monitoring Technologies	• Often referred to as Self-monitoring Analysis and Reporting Technology (SMART) • Technology is used to monitor clients' functional performance within the home and community • Utilizes wireless technology which allows the rehabilitation professional to provide services within a variety of environments without restricting clients' movements within those environments	***Advantages*** • Allows the rehabilitation professional to evaluate performance and modify services and the environment from an off-site location • Allows the rehabilitation professional to get a glimpse of clients in "real life", and witness any challenges they experience ***Disadvantages*** • Client and rehabilitation professional do not have real time interaction • Confidentiality (security of data, privacy) • Provider and clients comfort, experience, and expertise with technology

Type of Telerehabilitation Technology	Delivery Options	Characteristics of Delivery Option	Advantages / Disadvantages
			• Equipment accessibility • Availability (information, services)
	Virtual Reality (VR)	• Same as above	***Advantages*** • Rehabilitation provider receives a three-dimensional representations of the clients' movements, VR-based exercise progress, and motor performance updates • Remotely provides feedback and information as part of the rehabilitation intervention • VR can distract people from physical pain, and can increase their adherence to therapeutic exercises • Provides an effective method for clients to compare the difference between their desired level of functional performance and their current level of functional performance ***Disadvantages*** • Confidentiality (security of data, privacy) • Provider and clients comfort, experience, and expertise with technology • Availability (information, services) • Equipment accessibility • Cost-benefit ratio • Socioeconomic restrictions

Research examining the validity and reliability of using telerehabilitation in all steps of the assessment phase of the rehabilitation process has produced favorable results. Russell et al. (2010) attempted to measure the criterion validity and reliability of face-to-face and telerehabilitation during physical evaluation and diagnosis of 19 subjects with nonarticular lower limb musculoskeletal conditions. Each patient attended one 1.5 hour evaluation session that consisted of a patient interview, a face-to-face physical examination, and a physical self-examination guided by a physical therapist via telerehabilitation. Three physical therapists were randomly assigned to one of three settings (i.e., in-person evaluator, telerehabilitation evaluator, and telerehabilitation review evaluator) for each participant – each therapist was blinded to the evaluation results of the other two physical therapists to avoid bias. Each evaluators' results were recorded in a paper file and recoded for statistical analyses. The in-person evaluation was performed in a typical physical therapy clinical setting and involved a postural assessment, gait analysis, functional task analysis, observation and palpation of the painful area, joint range of motion testing, manual muscle testing, neural system tests, and clinical orthopedic tests for ligaments, joints, and tendons. The testing process was the same for the telerehabilitation evaluation, except for the telerehabilitation evaluator guiding the patient in self-examination of palpations, functional tests, and orthopedic assessments. Upon review of the collected data, each evaluator reported each patient's primary clinical diagnosis and a system diagnosis. Validity of telerehabilitation evaluation was analyzed by having the telerehabilitation review evaluator compare the primary clinical diagnosis and the system diagnosis reported for each patient by the in-person evaluator and the telerehabilitation evaluator. Interrater reliability was measured by having the telerehabilitation review evaluator independently assess each patient by viewing the recorded videos made by the telerehabilitation evaluator. Intrarater reliability was assessed by having the telerehabilitation evaluator reassess his/her patient again through the recorded video one month after the initial evaluation – this one-month time limit was considered sufficient to reduce or limit test–retest bias. The results found that for validity, interrater reliability, and intrarater reliability there was 63% or higher exact agreement on primary diagnosis and 79% or higher similar primary diagnosis agreement between the in-person evaluation setting and the telerehabilitation setting. A x^2 test showed that agreement in primary diagnosis for each patient for the two settings was statistically significant ($p < .05$). Weighted kappa analysis of categorical data revealed substantial agreement (0.61 and 0.80) in the study's validity and near perfect agreement (.81 and 1.00) in the study's interrater and intrarater reliability. A x^2 analysis of these results revealed that the agreement between the two settings was statistically significant ($p < .001$). Although participants stated a preference for face-to-face evaluation, they did state that they would refer telerehabilitation to a friend who could not travel. Additionally, participants reported having no issues with technical expertise or computer literacy.

Hoffmann et al. (2008) conducted a similar study comparing the validity and reliability of face-to-face and telerehabilitation assessment of activities of daily living and hand function of participants with Parkinson's Disease. Twelve subjects were randomized into either the face-to-face condition or telerehabilitation condition where they performed the following tests: 13 items from the motor component of the Functional Independence Measure (FIM), 14 items of the Unified Parkinson's Disease Rating Scale

(UPDRS), grip strength, pinch strength, and finger dexterity. Scoring of subjects' performance was completed by two therapists - the one performing the test (either the therapist in the face-to-face condition, or the telerehabilitation condition) and the therapist that was observing the testing (either the therapist in the face-to-face condition, or the telerehabilitation condition). For the FIM scoring between the two conditions, the validity of percent exact agreement was found to be 75% or higher, and the inter-rater reliability Intraclass Correlation Coefficient (ICC) was .95. For the UPDRS scoring between the two conditions, the validity of percent exact agreement 75% or higher for all items - except handwriting (41.6%), speech (50%), and bradykinesia (72.7%), and the inter-rater reliability ICC was .80. The intra-rater reliability of the FIM and UPDRS scoring had an ICC of .84. No differences were noted for scoring of grip and pinch strength between the two conditions. For the hand dexterity scoring, the mean difference between the two conditions was less than 1 second and had an inter-rater and intra-rater reliability ICC > .99. The findings of these two studies demonstrate that telerehabilitation is a valid and reliable service delivery option during the assessment phase of the rehabilitation process.

Several studies exploring the effectiveness of telerehabilitation in both steps of the intervention phase of the rehabilitation process have provided promising findings. Hermann et al. (2010) utilized a single case design to assess the efficacy of a functional electrical stimulation (FES) program administered through a neuroprosthesis and telerehabilitation on a patient who sustained a stroke. Data was collected prior to treatment and then one week after treatment using three assessments that rated the patient's hand and arm functioning as well as his occupational performance. The results showed that the patient had reduced arm and hand functional limitations and increased occupational performance. Another study conducted by Golomb et al. (2010) studied the benefits of an in-home remotely monitored virtual reality video game-based telerehabilitation. Three adolescent subjects with hemiplegic cerebral palsy were asked to exercise their affected hand 30 minutes a day, 5 days a week using a sensor glove fitted to the affected hand. The dependent variables that were used to track patient outcomes included the following: (1) standardized occupational therapy assessment; (2) remote assessment of finger range of motion (ROM) based on sensor glove readings; (3) assessment of affected forearm bone health with dual-energy x-ray absorptiometry (DXA) and peripheral quantitative computed tomography (pQCT); and (4) functional magnetic resonance imaging (fMRI) of hand grip task. The results revealed that all 3 participants had increased hand functioning of the affected hand and ability to lift objects, improved finger ROM, increased radial bone mineral content and area in the affected extremity, and expanded brain motor circuitry.

A third study conducted by Tousignant et al. (2014) investigated the use of an in-home telerehabilitation program for proximal humerus fractures. Seventeen participants received rehabilitation treatment for their injury at their home for 8 weeks via a teleconferencing system. All subjects were noted to significantly improve over the 8-week period on each measure – pain, shoulder range of motion, and upper limb function. These results provide evidence that telerehabilitation is an effective service delivery option for use during the intervention phase of the rehabilitation process.

In addition to the above mentioned telerehabilitation outcomes, telerehabilitation also offers benefits that address the various barriers to traditional service delivery options. These benefits include increased accessibility of services to clients who live in remote or underserved areas, improved access to providers and specialists otherwise unavailable to clients, prevented unnecessary delays in receiving care, decreased isolation of healthcare providers through distance learning, and increased ability for healthcare providers to consult with one another as well as perform research (Cason, 2012). The validity, reliability, effectiveness, and benefits of telerehabilitation have been documented in a variety of practice areas, such as wheelchair seating and positioning (Barlow, Liu, & Sekulic, 2009; Kim et al., 2008), orthopedic rehabilitation (Tousignant et al., 2014), neurology (Chumbler et al., 2010; Hermann et al., 2010), polytrauma (Bendixen et al., 2008), and cognitive rehabilitation (Girard, 2007; Germain et al., 2009), and with a variety of populations, like pediatrics (Cason, 2009; Cason, 2011; Golomb et al., 2010), working age adults (Bruce, & Sanford, 2006), and elderly (Bendixen, Horn, & Levy, 2007; Bendixen et al., 2009; Darkins et al., 2008). These examples demonstrate how telerehabilitation, as a service delivery option, can be translated, or generalized, to a wide variety of populations in many different practice areas. However, the question still remains whether telerehabilitation can be translated, or generalized, as a service delivery option in low vision rehabilitation with clients who are visually impaired.

A Cochrane Review performed by Bittner et al. (2020) compared the effects of telerehabilitation and face-to-face (e.g., in-office or inpatient) vision rehabilitation services for increasing vision-related quality of life and reading speed in people with vision impairments. This systematic review found several articles that provided evidence to support the feasibility, benefits, and effectiveness of the use of telehealth technology in ophthalmology. One example is a retrospective, noncomparative, consecutive case series study conducted by Mines et al. (2011) to explore the benefits of the U.S. Army Ocular Teleconsultation Program from 2004 – 2009. The authors concluded that the consultation program using telehealth technology provided significant tertiary level support to deployed providers which assisted in appropriate and timely referrals and prevented unnecessary evacuation. A second example was a literature review performed by Sreelatha and Ramesh (2016) to compare telehealth and face-to-face ophthalmology visits in diagnosing, monitoring, and managing clients with a variety of vision impairments. This literature search revealed that telehealth ophthalmology provided similar clinical outcomes as face-to-face visits while "allowing specialists to provide care over a large region through a remote portal," and maintaining high participant satisfaction and acceptance ratings due to increased accessibility and decreased traveling cost and time (Sreelatha & Ramesh, 2016, p. 294). The third example consists of two studies that investigated the use of consultation via telehealth with general ophthalmologists in rural areas - Johnson et al. (2015) in rural Western Australia, and Bai et al. (2007) in rural India. Both studies agreed that consultation through telehealth technology is an effective supplement to outreach ophthalmology services. The last example is a study by Tan et al. (2013) who compared the accuracy of diagnosing major causes of chronic blurry vision with telehealth ophthalmology versus a face-to-face visit. Thirty participants with chronic blurred vision were recruited to undergo vision testing (e.g., Snellen acuity, auto-refraction; intraocular pressure measurement, red-color perimetry, video recordings of extraocular movement, cover tests and pupillary reactions, and anterior segment and fundus photography) through telehealth ophthalmology and a face-to-face visit. Subjects also completed a user experience questionnaire at the end of the consultation. When compared to a face-to-face visit, telehealth ophthalmology attained “100% sensitivity and specificity in diagnosing media opacity (n = 29), maculopathy (n = 23) and keratopathy (n = 30) of any type; and 100% sensitivity and 92% specificity in diagnosing optic neuropathy of any type (n = 24)” (Tan et al., 2013, p. 65). In addition, most of the subjects (97%) reported being satisfied with the telehealth ophthalmology workflow and consultation.

These examples highlight the feasibility, benefits, and outcomes of the use of telehealth technology in the diagnosing, monitoring, and managing of residual visual functions. They also provide indirect support for the feasibility of using telehealth technology as a service delivery option for low vision rehabilitation in two ways. First, the video and sound quality were adequate to allow eye care professionals the ability to successfully interact with their patients in order to collect information about the patients’ history and eye condition symptoms. Information gathering is an important part of both stages of the low vision rehabilitation process (i.e., low vision assessment and low vision intervention) whether these occur in-person or through telerehabilitation. Without being able to effectively communicate with their clients’ low vision rehabilitation professionals would not be able to, for example, identify clients’ needs, evaluate clients’ quality of life, train clients on the correct use of prescribed devices, and establish an ongoing relationship with clients, Second, the video and sound quality was adequate enough for eye care professionals to accurately assess patients’ residual visual functions as well as perform a brief ocular exam. Likewise, low vision rehabilitation professionals need to be able to see and hear well enough – whether in-person or via technology – in order to, for instance, assess clients’ ability to perform their activities of daily living, train clients in compensatory techniques and skills, and perform environmental evaluation and modifications.

According to Bittner et al. (2020), the provision of low vision rehabilitation services through telerehabilitation has the potential to improve vision-related and health-related outcomes for people with vision impairments and may offer important advantages over traditional in-person low vision rehabilitation services. One advantage is that telerehabilitation services can help people with vision impairments overcome their transportation problems. Ihrig (2016), for example, reports that location is often one reason for poor utilization and access to medical and rehabilitation services; that is, people in rural areas often experience challenges in accessing these services due to the great distances that separate them from the urban areas where services are typically located. A second advantage is that eye care and low vision rehabilitation professionals can assess individuals with vision impairment functional performance in their natural, or home, environment which allows these professionals to offer more personalized care then if these interventions were performed in a clinic or office setting. Another advantage is that providing telerehabilitation services through the use of secure, internet-based communication technology, like computers, tablets, and smartphones, can expand the number of modalities available for eye care and low vision rehabilitation professionals to use with clients. A final advantage is that the use of telerehabilitation can improve efficiency of service provision through enhancing the use of time and other resources.

In 2016, Ihrig published a practice report that describes the use of low vision clinical video telehealth services that were offered at the Vision Impairment Services for

Outpatient Rehabilitation (VISOR) clinic that began in November 2012 at the Veterans Administration (VA) Medical Center in Buffalo, NY. Essentially, the VISOR program is a collaborative effort in combining the technical knowledge of eye care professionals (i.e., ophthalmologists and optometrists) and blind rehabilitation therapists in order to increase access to care and patient satisfaction.

At the annual meeting of the Association for Research in Vision and Ophthalmology (ARVO) in 2017, two abstracts were presented regarding the provision of low vision rehabilitation services through the use of telerehabilitation. The first abstract by Bittner et al. (2017) summarized a small sample quasi-experimental study that used synchronous telerehabilitation to deliver follow up low vision rehabilitation services to eight older adults with a bilateral vision loss caused by either age-related macular degeneration or diabetic retinopathy. One participant reported having experience with videoconferencing, and five participants reported having experience using the internet. The telerehabilitation sessions focused on training participants on how to use a magnifier in order to improve reading ability. Prior to beginning telerehabilitation services, all participants reported having trouble attending in-person low vision rehabilitation services at their eye care or vision rehabilitation professional's office or clinic. The researchers found that four participants reported being satisfied and four participants reported being very satisfied with the low vision telerehabilitation services they received. Results also showed that all participants stated feeling comfortable being evaluated and receiving low vision services through telerehabilitation. In addition, 75% of participants stated their use of a hand-held magnifier improved while reading after receiving telerehabilitation services, and 87.5% reported being very interested in receiving low vision telerehabilitation services again if their vision-related needs changed. As far as system quality, video quality was rated excellent by 3 (38%) participants and good by 4 (50%) participants, and audio quality was rated good to excellent by 5 (62.5%) participants. The second abstract by Ross et al. (2017) investigated the perceptions of three providers' (i.e., one licensed occupational therapist, and two optometrists) who utilized telerehabilitation to deliver low vision rehabilitation services to eight adults with a bilateral vision impairment of either age-related macular degeneration or diabetic retinopathy. These adults reported having difficulty attending low vision rehabilitation sessions at their providers' office, so they agreed to receive telerehabilitation services to learn how to use a hand-held magnifier for reading. Providers had no problems assessing seven participants' reading speed with a hand-held magnifier, and a little difficulty evaluating one participant's reading speed with a hand-held magnifier. They also had no difficulty measuring five participants' reading accuracy, and a little problem assessing three participants' reading accuracy which was mainly attributed to fair to poor audio quality. For determining working distance with a magnifier, providers only had a little difficulty with four participants and no difficulty with three participants. Overall, the providers felt that telerehabilitation would help seven of the eight (87.5%) participants improve their ability to use a hand-held magnifier.

Bittner et al. (2018) used a quasi-experimental design with a convenience sample of 10 participants with a diagnosis of macular pathology, and an age range of 63 to 91 ($\bar{x}$ = 80). Three participants who self-reported their vision as good had a distance visual acuity ranging from 20/60 to 20/88, and a best corrected near visual acuity ranging from 20/32 to 20/125. The other seven participants self-reported their vision as poor with a distance visual acuity ranging from 20/40 to 20/290, and a best corrected near visual acuity ranging from 20/10 to 20/320. All of the participants agreed to participate in the study due to having difficulty getting to a session in the providers' office. However, none of the participants reported having Wi-Fi in their home, and three participants stated they never used the internet prior to the study, and only two participants reported that they used videoconferencing before the study. Prior to beginning the use of telerehabilitation services, all participants had an in-office low vision evaluation of their best corrected near and distance visual acuity, contrast sensitivity, and presence of scotomas. After the in-office evaluation, eye care professionals utilized synchronous telerehabilitation technology to provide a single one-hour training session on the use of a magnifier to improve participants' reading ability. Results of the study showed that five participants agreed, and the other five participants strongly agreed that they were comfortable with being evaluated and receiving training through the use of telerehabilitation. Six out of 10 participants strongly agreed that the evaluation and training services received through telerehabilitation was as accurate as receiving in-person services. Eight out of 10 strongly agreed that they would be interested in receiving services again through telerehabilitation technology if their vision impairment status changed. Overall, six participants stated they were satisfied while four other participants stated they were very satisfied with receiving evaluation and training services through telerehabilitation. Furthermore, 8 out of 10 reported that their use of a magnifier improved after the one telerehabilitation session. The providers, on the other hand, reported feeling like the training they provided through telerehabilitation was helpful in improving participants' magnifier use. In fact, providers stated that they had little to no difficulty evaluating participants' reading speed and accuracy and judging the level of illumination. They found determining proper working distance with the magnifier as well as level of illumination was a little to moderately difficult depending on the type of tablet used by the participants.

Bittner et al. (2019) performed follow up research to the previously mentioned study (i.e., Bittner et al., 2018) where they utilized Lions Club volunteers to set up loaner telerehabilitation equipment for nine patients with low vision. Telerehabilitation was used to assess people with low vision use of newly prescribed magnification devices for near distance reading as well as provide training to patients with low vision to increase their performance on the reading items of the Activity Inventory (AI) questionnaire. The AI questionnaire was administered to the patients with low vision before their telerehabilitation session and then one to three months after their session. All participants reported being very satisfied with the telerehabilitation session. After the telerehabilitation session, most of the low vision patients reported having less difficulty reading handwritten notes with their prescribed magnification device, and half of the participants noted improving with reading bills and product labels with their prescribed magnification device. Overall, the authors found "the mean AI change score was 2.07 (range 0.33-6.08), indicating less difficulty with near reading for all patients, with a Cohen's d coefficient of 0.996, and 37.5% of patients achieved a minimum clinically important difference (MCID) criterion of ≥1" (Bittner et al., 2019, p. 4030). These improvements were similar to previous telerehabilitation clinical trial results, but providing assistance with volunteers to set up the telerehabilitation equipment for the participants helped to improve the number of people who were very satisfied with the telerehabilitation session from previous clinical trials.

The last study that addressed the provision of low vision rehabilitation services through telerehabilitation technology was conducted by Ihrig (2019). This study utilized a retrospective design to determine cost savings associated with as well as clients' acceptance and practicality of using telerehabilitation as a low vision rehabilitation service delivery model. Data was collected over a 5-year period on 419 veterans (406 males and 13 females) with an age range of 50 to 101 years ($\bar{x}$ = 83 years). The veterans had a variety of vision diagnoses that resulted in loss of visual acuity or peripheral vision: (a) 208 veterans had a best corrected visual acuity in both eyes up to 20/150; (b) 149 veterans had a best corrected visual acuity in both eyes of 20/200 or worse; (c) 22 veterans had noncorrected peripheral visual field loss in one or both eyes greater than 20 degrees; and (d) 40 veterans had noncorrected peripheral visual field loss in both eyes less than 20 degrees. Over a 5-year period, Ihrig (2019) found that the provision of low vision rehabilitation services increased 24% which resulted in a median travel miles saving of 122 miles per veteran, a median travel time saving of 2.09 hours per veteran, and a median travel cost saving of $65.29 per veteran. After each telerehabilitation session, veterans completed a low-vision telehealth survey that inquired about their telehealth experience, and their satisfaction with the telerehabilitation services they received. Of the 62 surveys reviewed, 100% of the veterans reported that the telerehabilitation services were timely, confidential and secure, informational, and helpful in their daily life. Survey respondents also mentioned that the telerehabilitation staff were caring, and that they were confident in their providers’ abilities. Lastly, all 62 veterans reported being satisfied with the telerehabilitation services they received.

These studies support the idea that low vision rehabilitation services through the use of telerehabilitation technology provide people with vision impairments a service delivery option that is practical, efficient, and cost effective. Although these studies do not unequivocally prove that low vision telerehabilitation services are as effective as in-person low vision rehabilitation services, they do suggest that low vision telerehabilitation services complement in-person low vision rehabilitation services well by increasing the utilization and early access of services for individuals with vision impairments who have difficulty traveling to providers’ offices or clinics. This increased utilization and early access to services can potentially prevent the individuals’ decline in functional ability which, in turn, will decrease the burden placed on caregivers and society. However, these studies do not explore the various stakeholders’ (i.e., eye care professionals, low vision rehabilitation professionals, and people with vision impairments) willingness to utilize and access these services; that is, if any stakeholder group is not willing to use telerehabilitation technology then this will inadvertently impact the other stakeholder groups. On one hand, if an eye care professional is unwilling to use telerehabilitation then they may not authorize a vision rehabilitation professional to use telerehabilitation technology to provide low vision rehabilitation services to a client with a vision impairment. On the other hand, if a client with a vision impairment is unwilling and refuses to use telerehabilitation services then neither the eye care professional nor the low vision rehabilitation professional could use the telerehabilitation technology services with this person, regardless of their professional preference.

Therefore, further research is needed to investigate the feasibility of telerehabilitation as a service delivery option in low vision rehabilitation which is largely centered around the behavioral intention to accept and use telerehabilitation among people with low vision and their service providers.

Synchronous Telerehabilitation

The above studies (i.e., Bittner et al., 2017; Bittner et al., 2018; Bittner et al., 2019; Bittner et al., 2020; Ihrig, 2016; Ihrig, 2019; Ross et al., 2017) provide support for the use of a synchronous mobile video conferencing system as the most appropriate method for delivery of low vision telerehabilitation services. Traditionally, in-person low vision rehabilitation services require clients to demonstrate the difficulties they are experiencing with their daily activities and show the low vision rehabilitation professional their ability to perform the compensatory and adaptive techniques that they were taught to remediate any functional impairments. In order for a low vision rehabilitation professional to perform these same physical observation tasks through telerehabilitation technology, the low vision rehabilitation clinician would need a mobile videoconferencing system that would connect the low vision rehabilitation professional in a hospital or clinic to a patient in the environment where they require rehabilitation (e.g., home, work, school, etc.) while allowing the client to have freedom to move around their environment. An example of this is a feasibility study performed by Lorenzini and Wittich (2019; 2020) where they studied the impact synchronous telerehabilitation has on the use of head mounted low vision assistive technology devices. The researchers randomly assigned 57 participants (age range = 21 – 82 years, $\bar{x}$ age = 54.5 years) to either the control group (i.e., self-guided training by the low vision assistive technology device vendor) or the experimental group (i.e., low vision assistive technology device training by a low vision therapist using telerehabilitation). Subjects had a significant improvement in quality of life (F (3, 129) = 2.83, p = .041, eta squared = .049) across all three time periods (i.e., 2 weeks, 3 months, and 6 months) for both conditions. The researchers also observed that subjects' functional vision significantly increased (F (3, 124) = 32.538, p < .001, eta squared = .372) across all three time periods for each condition. These studies did not report data on head mounted low vision assistive technology device use and abandonment, time frame longer than 6 months, or telerehabilitation accessibility and satisfaction which may have revealed a difference between self-guided training and telerehabilitation training with a low vision therapist. Regardless of this lack of additional data, these studies provide evidence that supports the use of synchronous telerehabilitation as a service delivery option for clients who are not able to access in-person low vision rehabilitation services.

The components of a synchronous telerehabilitation system that need to be considered in both the client's and clinician's location consist of a computer with a webcam and/or a mobile device with a camera, modem with wireless capabilities, and internet connection. These components have been analyzed for their advantages, disadvantages, and any specific feature that the clients may need in order for the telerehabilitation services to be successful, such as a computer needing a web camera for visual demonstration purposes (see Table 2). Figure 3 depicts how these components are set up and relate to one another to provide low vision rehabilitation services at a distance via telecommunication and information technology while figure 4 demonstrates how the client and clinician will interact via this mobile videoconferencing system.

Table 2: Components of a Telerehabilitation Mobile Videoconferencing System

Telerehabilitation System Components	Clinician's Location	Client's Location
Mobile Device(s) with a camera	• **Device:** tablet or smart phone • **Advantage:** provides the clinician with flexibility of movement without being tethered to a computer station • **Disadvantage:** the data exchange is less stable and secure since the exchange is occurring over a wireless connection • **Required Feature:** camera which will allow the use of videoconferencing software or application.	• **Device:** tablet or smart phone • **Advantage:** allows the client to move freely about his/her environment to demonstrate to the clinician any difficulties he/she may be encountering • **Disadvantages:** (1) the client would have to hold the device which restricts their performance of any task to the use of only one hand, or the client would "prop" up the device for "hands free" use which may restrict the clinician's field of view; (2) the data exchange is less stable and secure since the exchange is occurring over a wireless connection • **Required Feature:** camera which will allow the use of videoconferencing software or application. • **Device:** Google glass • **Advantages:** (1) allows the client to move freely about his/her environment to demonstrate to the clinician any difficulties he/she may be encountering; (2) allows the client to demonstrate tasks "hands free" • **Disadvantages:** (1) the data exchange is less stable and secure since the exchange is occurring over a wireless connection; (2) cost of the device
Computer with a webcam	• **Device:** computer with a webcam • **Advantage:** data exchange is more stable and secure since the computer is directly connected to the modem via an ethernet cable • **Disadvantage:** restricts flexibility of movement for the clinician • **Required Feature:** web camera which will allow the use of videoconferencing software or application.	Not applicable

Telerehabilitation System Components	Clinician's Location	Client's Location
Modem with wireless capabilities	**Type:** Direct connection to modem via Ethernet cable **Advantage:** (1) data exchange is more stable and secure; (2) fast upstream and downstream speeds; (3) high video quality **Disadvantages:** (1) speed and bandwidth can be negatively impacted by the number of devices connected to the modem; (2) movement is limited by cable **Type:** Wireless connection to modem **Advantage:** (1) movement is not restricted by a cable **Disadvantages:** (1) data exchange is less stable and secure; (2) speed and bandwidth can be negatively impacted by the number of devices connected to the modem; (3) medium to high video quality depending on speed and bandwidth; (4) device is limited to a certain coverage area that may result in "blackspots"	**Type:** Wireless connection to modem **Advantage:** (1) movement is not restricted by a cable **Disadvantages:** (1) data exchange is less stable and secure; (2) speed and bandwidth can be negatively impacted by the number of devices connected to the modem; (3) medium to high video quality depending on speed and bandwidth; (4) device is limited to a certain coverage area that may result in "blackspots"
Internet Connection	**Type:** broadband integrated services digital network (B-ISDN) **Advantages:** (1) high to very high bandwidth depending on the type of broadband; (2) high security of transmitted data; (3) fast upstream and downstream speeds; (4) high video quality due to fast video refresh rates **Disadvantage:** high cost due to installation costs, monthly maintenance fees, and per minute usage charges	**Type:** Broadband over Internet Protocol (IP) (e.g., Digital Subscriber Line (DSL)) **Advantages:** (1) commonly found in home environments; (2) moderate to fast upstream and downstream speeds; (5) cost is affordable **Disadvantages:** (1) low security of transmitted data; (2) medium to high bandwidth depending on the number of devices being utilized; (3) speed fluctuates depending on internet traffic, and availability of bandwidth; (3) moderate to high video quality due to video refresh rate

Note: Information in table was compiled from the following references Parmanto & Saptono (2009); and Pramuka & van Roosmalen (2009).

Figure 3: Telerehabilitation System Component Setup and Interaction

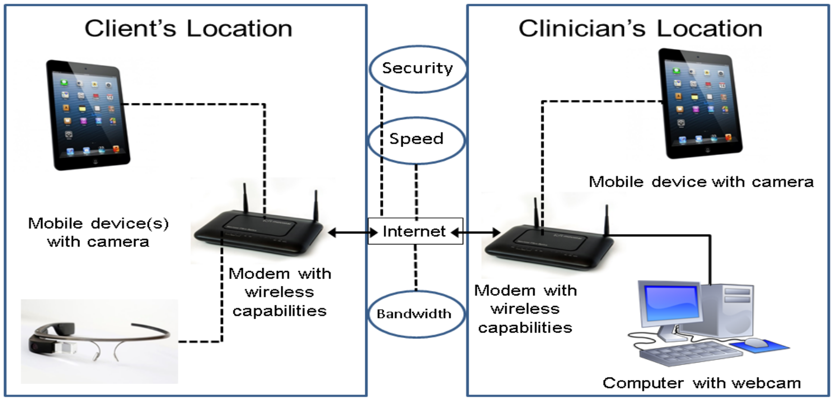
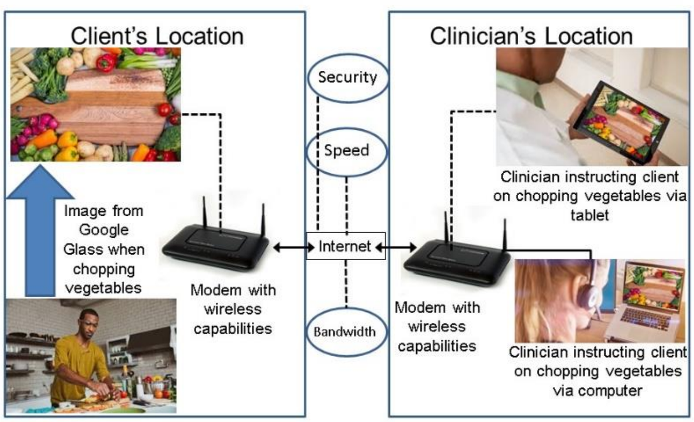


Figure 4: Interaction of Clinician and Client Using a Mobile Telerehabilitation System



Summary of Telehealth and Telerehabilitation

Since the target population uses technology, including mainstream computer-based technology, on a daily basis to accomplish everyday tasks, such as reading, writing, cooking, and communication, they are already aware and familiar with similar telecommunication and information technologies that are used to deliver healthcare services from a remote, or distant, location. The literature revealed that telehealth technology has been utilized to provide telerehabilitation services (1) in both phases (i.e., assessment and intervention) of the rehabilitation process; (2) in different practice areas, such as wheelchair seating and positioning, orthopedics, etc.; and (3) to different populations, like children, working age adults, and older adults. Most of these studies presented positive outcomes that not only supported the use of telerehabilitation as a viable service delivery option, but also described the benefits of using technology to deliver services that overcome many of the barriers people with disabilities experience with accessing and utilizing traditional rehabilitation services. Telehealth technology has been utilized in the diagnosing, managing, and monitoring of clients receiving ophthalmology and optometry services through telehealth. When compared to face-to-face visits these telehealth services have produced similar results - up to 100% sensitivity and specificity. Although these results are promising for the translation, or generalization, of using telerehabilitation as a low vision service delivery option, little evidence has been found to support this idea. Therefore, the purpose of this survey is to determine the personal characteristics the target population would ascribe to current low vision service delivery options compared to telerehabilitation as a low vision service delivery option. These characteristics are important in determining whether the target population will be persuaded to accept and utilize telerehabilitation as a service delivery option.

Theoretical Framework for the Behavioral Intention to Accept and Use Telerehabilitation

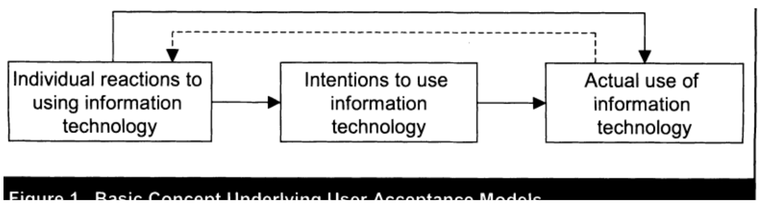
Current research suggests that telerehabilitation is a solution that could address many of the barriers facing the access and utilization of low vision rehabilitation services by people with vision impairments. When used as a supplement to in-person low vision rehabilitation services telerehabilitation also has the potential to meet the unique needs of people with vision impairments. Due to the lack of research in the use of telerehabilitation as a supplement to low vision rehabilitation services, there are many unanswered questions regarding the feasibility of implementing this technology. One main concern related to feasibility is determining if it is worthwhile to spend the time, energy, and money on telerehabilitation technology if eye care professionals, low vision rehabilitation professionals, and people with vision impairments are not willing to use it. This study investigates the behavioral intention of eye care professionals, low vision rehabilitation professionals, and people with vision impairments to access and utilize telerehabilitation technology as a supplement to in-person low vision rehabilitation services if and when they come available. This study utilizes the UTAUT theoretical framework to guide its methodology and instrumentation.

The Utility of the UTAUT Theoretical Model

There are a wide variety of models and theories that seek to explain people's behavioral intention to either accept and use, or reject and discard, a piece of technology. One theory that combines the variables and constructs from eight different theoretical models is the UTAUT (Venkatesh et al., 2003). Venkatesh et al. (2003) identified eight key competing theoretical models is the UTAUT model: (1) the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975); (2) Technology Acceptance Model (TAM) (Davis, 1989); (3) Motivational Model (MM) (Davis, Bagozzi & Warshaw, 1992); (4) Theory of Planned Behavior (TPB) (Ajzen, 1991); (5) Combined TAM and TPB (C-TAM-TPB) (Taylor & Todd, 1995); (6) Model of PC Utilization (MPCU) (Thompson, Higgins, & Howell, 1991); (7) Innovation Diffusion Theory (IDT) (Rogers, 2010); and (8) Social Cognitive Theory (Bandura, 1986; Compeau & Higgins, 1995). According to Venkatesh et al. (2003), all together these models put forth between two and seven determinants of technology acceptance that includes a total of 32 constructs. These models together have also identified four key moderating variables (i.e., age, gender, experience, and voluntariness) that affects the relationship between the independent variables of the 32 constructs and the dependent variable behavioral intention. Although these theories differ in the number of constructs and variables contained in each theory as well as the names of these variables and constructs, they all attempt to explain the relationships that lead to actual use of technology.

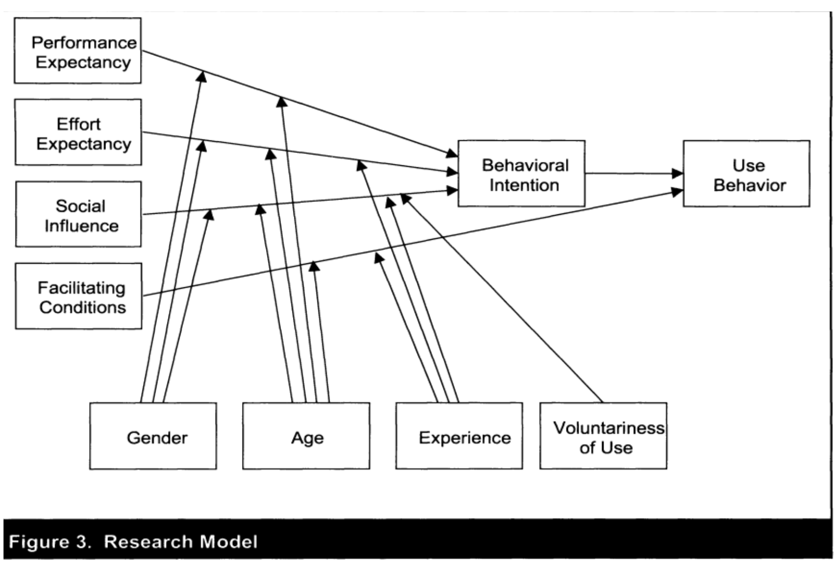
Venkatesh et al. (2003) described the basic underlying framework that outlines the relationships that influence people's choices to use technology (see Figure 5). The first relationship is people's individual reactions to use information technology and how these reactions influence people's intention to use information technology as well as their actual use of technology. Some examples of these individual reactions that influence individuals' use of technology are attitudes towards behavior, perceived behavioral control, perceived usefulness of technology, perceived ease of use of technology, and intrinsic and extrinsic motivation. The second relationship focuses on the effect people's intention to use technology has on their eventual actual use of that technology. The last underlying relationship noted by Venkatesh et al. (2003) is the impact actual use of technology has on individuals' reactions to using technology. These fundamental concepts related to technology acceptance and use have been incorporated into the iteration of the constructs and variables of the UTAUT (see Figure 6).

Figure 5: Basic Concept Underlying User Acceptance Models



Note: Reprinted with permission from Venkatesh et al. (2003).

Figure 6: UTAUT Model



Note: Reprinted with permission from Venkatesh et al. (2003)

The performance expectancy construct is defined by Venkatesh et al. (2003) as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (p. 447). This performance expectancy construct within each model or theory was found to be the strongest predictor of intention and remained significant at all points of measurement for both voluntary and mandatory settings.

Venkatesh et al. (2003) defined the effort expectancy construct as "the degree of ease associated with the use of the system" (p. 450). Effort oriented constructs are thought to be more prevalent in the early stages of a novel behavior because process issues (i.e., how the technology works) are more challenging for people, but with continued experience these challenges become dominated by instrumentation challenges (Davis et al., 1989; Venkatesh, 1999).

The third construct in the UTAUT model is social influence which is defined by Venkatesh et al (2003) as "the degree to which an individual perceives that important others believes he or she should use the new system" (p. 451).

Facilitating conditions is the fourth construct in the UTAUT model and is defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (Venkatesh et al, 2003, p. 453). Venkatesh et al. (2003) found that the facilitating conditions construct is not predictive of intention unless the effort expectancy construct is absent from the model. However, Venkatesh et al. (2003) found that the facilitating conditions construct does have a direct influence on use behavior.

The last construct in the UTAUT model is behavioral intention. Behavioral intention is described as individuals' acceptance and planned use of a new technology.

Like all eight of the key competing theoretical models of technology acceptance and use, the UTAUT model concluded that behavioral intention has a significant positive influence on actual use behavior of new technology.

Moderator Variables

Venkatesh et al. (2003) incorporated all four moderator variables (i.e., age, gender, voluntariness, and experience) that were either implicitly or explicitly implied by the eight key competing theoretical models of technology acceptance and use into the UTAUT model. The influences these moderator variables were hypothesized to have on behavioral intention or use behavior varied for each of the constructs. For example, the relationship between performance expectancy and behavioral intention was believed to be moderated by both age and gender. Gender oriented research has found that men tend to be highly task-oriented which means that the performance expectancy items that address task accomplishment will be especially pertinent to men (Minton and Schneider, 1980). However, these gender differences are thought not to be genetically linked, instead they are noted to arise from gender roles and socialization processes that occur and are reinforced from birth (Kirchmeyer, 2002; Lynott & McCandless, 2000). In regards to these gender roles, Kirchmeyer (2002) and Twenge (1997) have shown that gender roles are relatively enduring, but are open to change over time. Research related to age and performance expectancy revealed that younger workers may be more motivated by extrinsic rewards (Hall & Mansfield, 1975). Both age and gender have been noted to significantly influence technology adoption (Morris & Venkatesh, 2000; Venkatesh & Morris, 2000). In fact, Levy (1988) suggests that studies of gender differences can be misleading without considering age. For instance, the influence of certain job-related factors may significantly change for women as they reach child-rearing age. Thus, Venkatesh et al. (2003) hypothesized that performance expectancy would be moderated by both age and gender:

Similarly, the relationship between social influence and behavioral intention is also thought to be moderated by age and gender. Specifically, social influence was found to be more salient in forming an intention to use new technology for women and those that are older (Venkatesh et al, 2003; Morris and Venkatesh, 2000).

A third example is the hypothesis that gender, age, and experience moderate the relationship between effort expectancy and behavioral intention. Venkatesh and Morris (2000) propose that effort expectancy is more salient for women than men which, as stated previously, is most likely due to gender roles (e.g., Lynott & McCandless, 2000). Increasing age is also thought to be a stronger determinant of effort expectancy because it is associated with increased difficulty processing complex stimuli and allocating attention to technology-related information. Thus, Venkatesh et al (2003) hypothesize that this construct would be moderated by gender, age, and experience.

The final example is the belief that age, and experience moderate the relationship between facilitating conditions and use behavior. Venkatesh et al. (2003) predicted that facilitating conditions is more prominent in use behavior when moderated by increasing age and experience.

Empirical Validation of the UTAUT Model

After describing the UTAUT model, Venkatesh et al. (2003) conducted a preliminary test of the model's constructs and variables using data collected from field studies at four organizations where employees were being introduced to new technologies. From this data a measurement model was estimated that contained seven direct determinants of intention. The internal consistency reliabilities of all constructs were within the acceptable range (greater than 0.70). Convergent and discriminate validities of the model were confirmed by “the square roots of the shared variance between the constructs and their measures were higher than the correlations across constructs” (p. 457). In addition to reliability and validity, Venkatesh et al. (2003) also conducted a power analysis to examine the potential for committing a type II error. They concluded that there was a 95% likelihood of detecting a medium effect with an alpha level of .05, and less than a 50 percent likelihood of detecting small effects.

After determining the model’s reliability, validity, and effect size, the researchers confirmed their hypotheses regarding each construct (i.e., performance expectancy, effort expectancy, facilitating conditions, and social influence), including the associated moderator variables (Venkatesh et al., 2003). First, performance expectancy was found to have a direct effect on behavioral intention with the interaction between these two variables being moderated by gender and age; that is, performance expectancy was more prominent to younger workers who were men. Second, a direct effect was noted between effort expectancy and behavioral intention with their interaction being moderated by gender and age (i.e., effort expectancy was more relevant to women, especially older women). Experience was found to be another moderator variable that influenced the relationship between effort expectancy and behavioral intention. In other words, the effect of effort expectancy was greater when experience with a technology was minimal, but was noted to decrease as experience with the technology increased. Third, social influence also had a direct effect on behavioral intention with the interaction between these two variables being moderated by voluntariness of use, gender, age, and experience. Therefore, social influence was more noticeable for people in mandatory settings, women, older individuals, and people in the early stages of experience with a technology. Fourth, facilitating conditions was not significant as a predictor for behavioral intention, but was a predictor of use behavior. Lastly, the self-efficacy, anxiety, and attitude constructs also did not have a direct effect on behavioral intention. Thus, these three constructs were dropped from the UTAUT model.

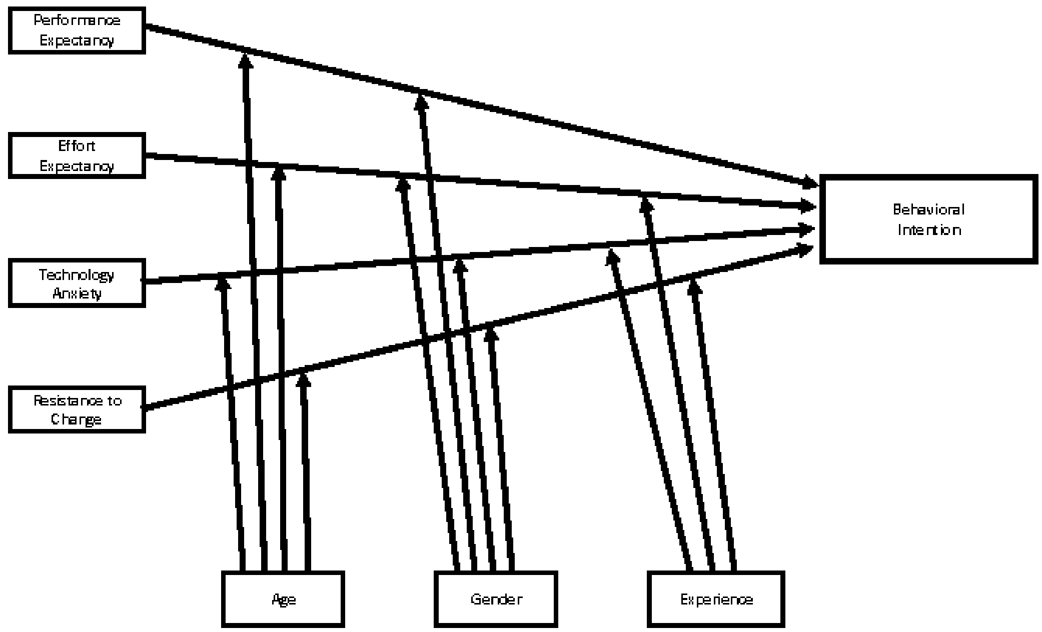
Venkatesh et al. (2003) found that facilitating conditions and behavioral intention were both significant predictors of use behavior. The interaction between facilitating conditions and use behavior were found to be moderated by age (i.e., facilitating conditions were more important for older workers) and experience (i.e., the effect was greater for those with increasing technology experience).

As a follow-up to their preliminary study, Venkatesh et al. (2003) collected data from two more organizations to further validate the UTAUT model as well as to add external validity to the preliminary study results. The data collection and analysis procedures for these two organizations were the same as the procedures utilized in the preliminary study. Results from this study were consistent with those previously mentioned from the preliminary study. Thus, the UTAUT model was found to be a valid, reliable, and robust model for measuring technology acceptance and use.

Adapting and Extending the UTAUT Model

The UTAUT model is a "definitive model that synthesizes what is known about access and use of assistive technology and provides a foundation to guide future research in this area. By encompassing the combined explanatory power of the individual models and key moderating influences, UTAUT advances cumulative theory while maintaining a parsimonious structure" (Venkatesh et al., 2003, p. 467). The developers of the UTAUT model have created a valid, reliable, and robust framework for studying the acceptance and use of new technology that can be adapted and/or extended to represent a variety of different settings. The researchers also recognize the model's flexibility by encouraging future research to identify and test additional boundary conditions of the UTAUT model in order to provide a greater understanding of technology acceptance and use behavior. Recent literature has demonstrated that expansions and adaptations of the UTAUT model are dependent on population and context (e.g., Cimperman et al., 2016; Malkani & Starik, 2014; Venkatesh et al., 2011; Isaias et al., 2017). Similarly, the current study adapts and extends the UTAUT model by applying it to a new population and context which has not been previously addressed in the literature (i.e., the behavioral intention of clients and professionals to use telerehabilitation as a supplement to in-person low vision rehabilitation services). Thus, the following section discusses the elements of the UTAUT model that were not retained, the components of the model that were retained, and the extensions of the model (see Figure 7) used in this study.

Figure 7: Model of Telerehabilitation in Low Vision Rehabilitation Service Provision



UTAUT Model Elements Not Retained

Three elements from the original UTAUT model were not retained for this study. One element that was not retained was the social influence construct. As previously stated, social influence is the extent to which a person interprets whether other significant people in his or her life believe that he or she should use a new technology (Venkatesh et al., 2003). In both their preliminary and cross validation studies of the UTAUT model, Venkatesh et al. (2003) found that the social influence construct was only significant for determining behavioral intention in mandatory settings (i.e., settings where individuals were required to use a new technology). Liu et al. (2015) obtained similar results when studying the factors that influenced therapists' behavioral intention and use behavior of new technologies at a large rehabilitation hospital in Canada. They stated that the social influence construct was not a relevant factor for behavioral intention to use new technologies in rehabilitation for two reasons. One reason is that their study was conducted in a voluntary setting where therapists had the opportunity to choose which technologies to use with their patients. The other reason is that, as autonomous practitioners, speech, physical, and occupational therapists are used to making independent decisions regarding their behavioral intention to use a new technology and are less likely to be influenced by the opinions of other members of the healthcare team. Therapists' autonomy also prevents them from having to comply with others' expectations of behavioral intention to use a new technology because their decision cannot be rewarded or punished. Since this study will take place in a voluntary context where clients with vision impairments and professionals who work with them will not be required to use telerehabilitation, the social influence construct was not retained in this model.

The second element that was not retained in this study's model is the facilitating conditions construct. Facilitating conditions, as stated above, is the extent of a person's belief that an infrastructure is present to support the use of a new technology (Venkatesh et al, 2003). According to the original study, facilitating conditions does not have a direct relationship with behavioral intention, but is a direct determinant of use behavior. When studying therapists' behavioral intention and use behavior of new technologies in a large rehabilitation hospital Liu et al. (2015) found that facilitating conditions did not predict behavioral intention and did predict use behavior of the new technology. Hoque and Sorwar (2017) also noted that facilitating conditions did not predict elderly Bangladesh subjects' behavioral intention to use mobile health services technology; however, in the same study, facilitating conditions were found to be a direct determinant of use behavior for mobile health services. Since the current study is in the early stages of research into the acceptance and use of telerehabilitation in low vision rehabilitation service provision, the study is utilizing behavioral intention as the outcome variable rather than use behavior as the outcome variable. Therefore, the facilitating conditions construct was not retained in the current study's model because it was found to only predict use behavior and not behavioral intention.

The last element of the UTAUT model that was not retained in this study is the voluntariness of use moderator variable. This variable addresses what type of setting new technology is introduced into and used; that is, new technology can be introduced into a setting where its use is mandatory, or the new technology can be introduced into a setting where its use is voluntary. In the current study, low vision rehabilitation is a voluntary setting where clients with vision impairments and the professionals who work with them can choose to use any service, including telerehabilitation, without coercion or repercussions. Thus, this study did not retain the voluntariness of use moderator variable because the low vision rehabilitation setting does not vary between voluntary and mandatory.

UTAUT Model Elements Retained

Four elements from the original UTAUT model were retained for this study. One element that was retained is the performance expectancy construct. This construct addresses the extent to which a person believes that using the new technology will improve his or her performance in an activity. Venkatesh et al. (2003) stated that this construct was the most significant determinant of behavioral intention. Liu et al. (2015) found similar results with therapists' behavioral intention to use new technologies in a large rehabilitation hospital. Other current research also reports that performance expectancy is a significant predictor of behavioral intention, such as Hoque and Sorwar's (2017) study of elderly Bangladesh subjects' behavioral intention to use mobile health services technology, and Quaosar et al.'s (2018) research to assess elderly participants' behavioral intention to use m-health services in developing countries, and Wang et al.'s (2009) investigation of the factors that influence students' behavioral intention to use m-learning. Due to the ability of the performance expectancy construct to predict behavioral intention this construct was retained for this study.

Another element that was retained in this study's model is the effort expectancy construct. Effort expectancy is the extent to which a new technology appears easy to use. In their original study, Venkatesh et al. (2003) discovered that effort expectancy was a significant predictor of behavioral intention in voluntary and mandatory settings, but only when the new technology was first introduced. One study's results were contrary to these original findings by concluding that effort expectancy was not a significant determinant of behavioral intention (Liu et al., 2015). Liu et al. (2015) explained several reasons for these conclusions. One reason is that new technologies in rehabilitation settings are designed to improve both the clients' outcomes and the practitioners' job performance (i.e., effort expectancy), so even learning how to use a new challenging technology is not viewed as an obstacle for either the clients or practitioners. A second reason is that most of the technologies examined in the study have been used by the therapists for a period of approximately 3 years which confirms

Venkatesh et al.'s (2003) finding that effort expectancy was only pertinent in the early stages of use. The third reason why effort expectancy was not found to be a significant predictor of behavioral intention is that the technologies investigated (i.e., iPads and games on tablets) are not novel technologies to therapists who utilize them regularly with clients. A final reason is that practitioners' perceptions of how difficult a low-tech device was to use overshadowed their perceptions of how difficult a high-tech device was to use. Despite these findings, three other studies of m-health and m-learning provide empirical support to Venkatesh et al.'s (2003) original findings that effort expectancy was a significant predictor of behavioral intention (e.g., Hoque and Sorwar, 2017; Quaosar et al., 2018; Wang et al., 2009). For this study, effort expectancy was retained, because the use of telerehabilitation in low vision rehabilitation service provision is in its early stages of research for both clients and practitioners which means effort expectancy should be a salient factor of behavioral intention.

Several moderator variables from the original UTAUT model were retained as another element for this study. Age, for example, is one moderator variable that was retained due to Venkatesh et al. (2003) concluding that age significantly influenced the strength of the relationship between the performance expectancy and effort expectancy constructs and behavioral intention. Hoque and Sorwar (2017) found that age influenced the relationship between the performance expectancy and effort expectancy constructs and behavioral intention as well as the relationship between the technology anxiety and resistance to change constructs and behavioral intention. These findings that age influences the relationships between these constructs (i.e., performance expectancy, effort expectancy, technology anxiety, and resistance to change) and behavioral intention were further supported by a systematic review of the literature conducted by Peek et al. (2014). In all, this empirical evidence supports the decision to retain this moderator variable in the current study.

Gender is another moderator variable that was retained in this study's model because of its influence on the strength of the relationship between the performance expectancy and effort expectancy constructs and behavioral intention (Venkatesh et al., 2003). Wang et al.'s (2009) results concurred with the original results that gender moderated the influence between the performance expectancy and effort expectancy constructs and behavioral intention. In addition to these same results, Hoque and Sorwar (2017) also found that gender moderated the relationship between the technology anxiety and resistance to change constructs and behavioral intention. Thus, these studies help to reinforce the decision to retain gender as a moderator variable.

The last moderator variable that was retained in this study was experience. According to Venkatesh et al.'s (2003) study, experience significantly influenced the relationship between effort expectancy and behavioral intention. Liu et al. (2015) also found that experience influenced the relationship between effort expectancy and behavioral intention. In fact, they found that effort expectancy was not a significant predictor of behavioral intention as experience with new technologies increased. Although Hoque and Sorwar (2017) do not directly mention the effect experience has on the relationship between the technology anxiety and resistance to change constructs and behavioral intention, they allude to the fact that experience does have an influence on the relationship between these constructs and behavioral intention. For the relationship between technology anxiety and behavioral intention, experience appears to have a negative influence. That is, the more experience a person has with technology the less likely the person will report having anxiety using a new technology which, in turn, will increase the person's behavioral intention to use a new technology. For the relationship between resistance to change and behavioral intention, experience has a potential influence on the relationship, but the direction of the influence (i.e., positive or negative) is unclear. Therefore, experience was retained in this study's model as a moderator variable to validate its influence on effort expectancy as well as to obtain a more precise direction of the influence experience has on the technology anxiety and resistance to change constructs.

A final element that was retained in this study's model is behavioral intention. In the original UTAUT model, behavioral intention is viewed as a construct that significantly predicts individuals' use behavior of a new technology. However, some studies, like Wang et al. (2009), report behavioral intention was used as the outcome, or dependent, variable because the research is still in its infancy, and, thus, could not accurately make inferences to use behavior. Similarly, the research regarding the use of telerehabilitation in low vision rehabilitation service provision is still in its infancy, and in order to avoid making incorrect inferences this study retained behavioral intention as a dependent variable, instead of as a construct.

UTAUT Model Extensions

Two constructs were added to this study which are extensions to the original UTAUT model. One construct that was added is technology anxiety. Technology anxiety is defined as the "fear or discomfort people experience when they think of using technology" (Hoque and Sorwar, 2017, p. 79). In their preliminary and cross validation studies, Venkatesh et al. (2003) noted that technology anxiety was not a direct determinant of behavioral intention. Though studies have found technology anxiety to be conceptually and empirically distinct from the effort expectancy construct, Venkatesh (2000) modeled technology anxiety as indirect determinants of behavioral intention fully mediated by effort expectancy. In contrast, a study by Hoque and Sorwar (2017) revealed that technology anxiety was a significant, but negative, predictor of behavioral intention. In other words, the more fear or discomfort individuals experience when they think of utilizing a new technology the individuals' behavioral intention to use that technology will decrease. Other studies have revealed similar results regarding the technology anxiety construct being a significant negative predictor of behavioral intention, such as Tung and Chang's (2008) study of the factors influencing nursing students use of an online course, and Guo et al.'s (2013) research on elderly people's acceptance and use of mobile health services. Since the current study investigates a relatively new approach to providing low vision rehabilitation services through the use of telerehabilitation, both clients with vision impairments and the professionals who work with them may be wary or uncomfortable about using this new technology. Therefore, this study has added technology anxiety to the model to determine its influence and effect on behavioral intention.

Another construct that was added to this study's model is the resistance to change construct. An individual's resistance to change from using his or her current technology to using a new technology has a negative effect on behavioral intention by reducing the individual's likelihood of using the new technology (Hoque & Sorwar, 2017). This construct was not addressed in the Venkatesh et al. (2003) original UTAUT model, but was noted to be a significant, yet negative, determinant of behavioral intention in Hoque and Sorwar's (2017) study on elderly Bangladesh subjects' behavioral intention to use mobile health services technology. This conclusion may be due to the new technology being introduced into a voluntary setting where people make autonomous decisions, and their behavioral intention to use or not to use a technology cannot be rewarded or punished (Liu et al., 2015). If this is the case, then this study should include the resistance to change construct in the model because people with vision impairments and the professionals who work with them can independently choose whether or not to use telerehabilitation without a reward or penalty. As a result, these participants may be more resistant to change from traditional face-to-face low vision rehabilitation service provision to telerehabilitation service provision which will negatively affect the behavioral intention to use the technology.

Summary of the Theoretical Framework for Telerehabilitation

In conclusion, this study uses a framework based largely on the UTAUT model. Since the use of telerehabilitation in low vision rehabilitation service provision is in its infancy this study included constructs from other studies that have a high likelihood of predicting behavioral intention (e.g., Hoque & Sorwar, 2017; Liu et al., 2015). In all, this study's model provides a comprehensive view of technology acceptance and use by incorporating a variety of theoretical perspectives.

Conclusion

This chapter addresses the challenges people with vision impairments often face which can also negatively affect caregivers and society. The number of people with vision impairments who are experiencing occupational performance dysfunction is anticipated to increase with the aging of society. This literature review examines the growing body of research that state in-person low vision rehabilitation services are currently the “gold standard” for effectively addressing the limitations placed on occupational performance for those with a moderate to severe vision impairment. However, the awareness, access, and utilization of traditional in-person low vision rehabilitation services is quite poor, even in developed countries like the United States. One solution to this problem that this chapter discusses is the use of telerehabilitation. Although the literature provides a plethora of support for the use of telerehabilitation in a variety of rehabilitation settings with a variety of populations, a gap exists in the literature that supports the use of telerehabilitation in the provision of low vision rehabilitation services. In fact, the only literature that supports the use of telerehabilitation services consists of one case report on how telerehabilitation is used to provide low vision rehabilitation services in the Veterans Administration Health System; three small sample sized studies that were limited to improving reading performance; and one retrospective study that looked at the miles, cost, and time savings that resulted from the use of telerehabilitation low vision services as well as all participants being satisfied with the use of telerehabilitation services.

As this literature review discusses, the use of telerehabilitation to provide low vision rehabilitation services is only in its infancy and has not reached a tipping point for the majority of people with vision impairments and the professionals who work with them to adopt telerehabilitation as a service delivery option. More research is needed with larger sample sizes to provide evidence for the effectiveness of telerehabilitation services to influence the increased use of telerehabilitation as a viable service delivery option. Prior to adding to this body knowledge, this study examines the need to, first, investigate the stakeholders' (i.e., people with vision impairments, eye care professionals, and vision rehabilitation professionals) behavioral intention to use telerehabilitation as a service delivery option. This literature review proposes that behavioral intention to use telerehabilitation is influenced by four constructs: performance expectancy, effort expectancy, technology anxiety, and resistance to change; however, no literature exists that supports this claim specifically for the use of telerehabilitation in low vision rehabilitation. Thus, this research project seeks to address this gap in the literature related to behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option.

Given the above mentioned gaps in the literature, this research project addressed the following shortcomings in the literature: (1) a lack of support for stakeholders behavioral intention to use telerehabilitation as a services delivery option; (2) a lack of research that addresses the constructs and variables that influence stakeholders' behavioral intention to use telerehabilitation as a service delivery option; (3) a scarcity of evidence regarding the feasibility of using telerehabilitation to provide low vision rehabilitation services; and (4) limited literature on adapting and extending the UTAUT in the area of low vision rehabilitation. A pre-validated internet-based survey was conducted to collect data related to these areas. Chapter Three describes this survey, and the study's methodology.

Chapter 3

Methodology

This chapter describes the methodology utilized in the current study to investigate intention to use telerehabilitation technology among people with low vision and their service providers. The chapter describes the study's research design, target population, sample description and recruitment, survey design, procedure, data collection plan, and data analysis plan.

This quantitative, non-experimental, descriptive study followed a cross-sectional survey design using a pre-validated instrument accessed over the Internet. Part One of the survey asked about which group participants represented when answering the remainder of the survey (i.e., people with vision impairments, eye care professionals, and vision rehabilitation professionals) and determined if participants met the inclusion criteria. Part Two of the survey inquired about the participants' demographic factors, such as age, gender, experience as a professional who works with people who have vision impairments, and number of years with a vision impairment. Part Three of the survey explored the various predictors of participants' behavioral intention (i.e., performance expectancy, effort expectancy, technology anxiety, and resistance to change) which directly aligns with this study's hypotheses.

Research Design

Various quantitative descriptive studies have successfully investigated people's behavioral intention and use behavior of consumer technology (e.g., Cenfetelli & Schwartz, 2011; Macedo, 2017), educational technology (e.g., Sumak & Sorgo, 2016; Tan, 2013; Wang et al., 2009), rehabilitation technology (e.g., Liu et al., 2015; Walker, 2014), healthcare information technology (e.g., Kim et al., 2016; Maillet et al., 2015; Phichitchaisopai & Naenna, 2013), and telehealth technology (e.g., Adenuga et al., 2017; Cimperman et al., 2016;; Hoque & Sorwar, 2017). Descriptive studies, like these, commonly utilize surveys, especially in the health sciences, to either gather “new insights and new ways of thinking about causes and effects,” or to develop “new theory and study new fields of inquiry” (Flannelly and Jankowski, 2014, p. 26). Most survey descriptive studies are conducted at one point in time employing a cross-sectional design. A cross-sectional design is useful when the researchers want to (1) measure all of the study’s variables at the same time; (2) identify associations that may exist between the variables; and (3) generate hypotheses from these associations for future research (Setia, 2016). Since no published studies have formally researched the behavioral intention to use telerehabilitation as a service delivery option among people with vision impairments and the professionals who work with them, this study utilized a cross-sectional descriptive study design to survey people with vision impairments and the professionals who work with them, in the United States, in order to measure their behavioral intentions to use telerehabilitation to supplement current face-to-face low vision rehabilitation services. The survey used in this study can be found in Appendix 1.

Variables

The UTAUT provides the theoretical framework for this study (Venkatesh et al., 2003). This theory has been adapted and extended to include the constructs and variables that are specifically relevant to the acceptance and use of telerehabilitation technology as a low vision rehabilitation service delivery option. Specifically, the constructs of performance expectancy, effort expectancy, technology anxiety, resistance to change, and behavioral intention to use technology have been incorporated to guide the development of this research and subsequent survey questions.

Table 3 lists and defines the independent, moderator, and dependent variables that were used in this survey. There are four independent variables, or predictors, that influence potential users to either accept and use telerehabilitation technology or reject and discontinue telerehabilitation technology. One predictor is performance expectancy, which is the extent to which people believe that using a telerehabilitation system will help them improve overall functional performance. The second predictor is effort expectancy, which is the anticipated ease associated with using a telerehabilitation system. Another predictor is technology anxiety, which is the fear or discomfort people experience when they think of using telerehabilitation technology. The last predictor is resistance to change, or individuals' likelihood of changing from solely using face-to-face low vision rehabilitation services to using a combination of face-to-face and telerehabilitation low vision rehabilitation services.

Table 3: Variables and Their Operational Definitions

	Variables	Operational Definition
	Potential Users of Telerehabilitation in the U.S.	
IV	People with Vision impairments	People who are adults 18 years of age or older, and have a visual acuity of $\leq$ 20/60, or central visual field $\leq$ 20 degrees)
	Eye care professionals	Ophthalmologists or optometrists that practice, at least, part time in the United States, and are licensed or registered as a medical doctor or doctor of optometry in the state they practice; these eye care professionals actively treat people

	Variables	Operational Definition
		who have moderate to near total vision impairments, and are adults 18 years of age or older.
	Low vision rehabilitation professionals	Certified Low Vision Therapist (CLVT), Certified Rehabilitation Counselor (CRC), Certified Vision Rehabilitation Therapist (CVRT), Certified Orientation and Mobility Specialist (COMS), and Occupational Therapist Licensed (OT/L)) that practice, at least, part time in the United States, and actively work with people who have moderate to near total vision impairments; they are adults 18 years of age or older.
	Performance expectancy	The extent to which people believe that using a telerehabilitation system will help them improve overall functional performance
	Effort expectancy	The anticipated ease associated with using a telerehabilitation system
	Technology anxiety	The fear or discomfort people experience when they think of using telerehabilitation technology.
	Resistance to change	The likelihood individuals will change from face-to-face low vision rehabilitation services to using a combination of face-to-face and telerehabilitation low vision rehabilitation services
	Age	How old a person is in years
	Gender	Male, Female, or other gender label specified by the individual
MV	Experience	Amount of experience as a professional working with those who have moderate to near total vision impairment
		Amount of experience as a person with a moderate to near total vision impairment
DV	Behavioral intention	Individuals' acceptance and planned use of telerehabilitation technology
	Use behavior of telerehabilitation	Individuals' use of telerehabilitation, including the number of years they have used telerehabilitation

Note: IV = Independent Variable, MV = Moderator Variable, DV = Dependent Variable

Moderator Variables

Moderator variables influence the strength of the relationship between the predictors and the outcome, or dependent, variable. Several demographics were collected from the participants to determine if they acted as moderator variables. Age, gender, and experience have been found to moderate, or influence, the relationship between the performance expectancy, effort expectancy, technology anxiety, and resistance to change predictors and behavioral intention to use technology (Venkatesh et al., 2003; Venkatesh et al., 2012).

Dependent Variable

This study uses the following dependent, or outcome, variables: (1) behavioral intention to use telerehabilitation technology, which is defined as an individual's acceptance and planned use of telerehabilitation technology; and (2) use behavior of telerehabilitation technology, which is determined by whether or not an individual uses telerehabilitation technology, and the number of years an individual has used telerehabilitation technology.

Population and Sample Description

Data Sources

Eye care professionals were recruited from the following sources: (a) professional organizations - American Academy of Ophthalmology, American Board of Ophthalmology, American College of Eye Surgeons, American Glaucoma Society, American Ophthalmological Society, American Society of Cataract & Refractive Surgery, American Society of Retina Specialists, Association for Research in Vision and

Ophthalmology, Foundation Fighting Blindness, Research to Prevent Blindness, American Academy of Optometry, American Optometric Association, and American Optometric Foundation; (b) state or private clinics or agencies; (c) professional listservs; and (d) social media sites - Facebook, LinkedIn, Instagram, YouTube, and Twitter.

Low vision rehabilitation professionals were recruited from the following sources: (a) professional organizations - Academy for Certification of Vision Rehabilitation & Education, Association of Vision Rehabilitation Therapists, and American Occupational Therapy Association; (b) state or private clinics or agencies; (c) professional listservs; and (d) social media sites - Facebook, LinkedIn, Instagram, YouTube, and Twitter.

People with a moderate to near total vision impairment were recruited from the following sources: (a) social media sites and groups – Facebook, LinkedIn, Instagram, YouTube, and Twitter; (b) state and private agencies that serve people with vision impairments; and (c) consumer organizations that advocate for people that are visually impaired - National Federation of the Blind (NFB), American Council of the Blind (ACB), and American Foundation of the Blind (AFB).

Target Population

The target population for this study consisted of three groups of potential users of telerehabilitation as a low vision service delivery option:

1) Eye care professionals – This group consists of ophthalmologists that are certified by the board of ophthalmology, and optometrists who are fellows of the American Academy of Optometry Low Vision Section. The American Board of Ophthalmology reports that it certifies 30,392 ophthalmologists (https://abop.org/about/examination-statistics/). Not all of these

ophthalmologists work with people who have moderate to near total vision impairment. For instance, the American Academy of Ophthalmology lists 25 members in the United States with a documented subspecialty in low vision rehab (https://secure.aao.org/aao/find-ophthalmologist). Another example is the number of members in the United States with a documented subspecialty of people who typically experience moderate to near total vision impairment, such as 98 members with a subspecialty in cataract and anterior segment disorders, 94 members with a subspecialty in corneal and external ocular disorders, 98 members with a subspecialty in glaucoma, and 95 members with a subspecialty in retinal and vitreous conditions. The American Academy of Optometry lists 38 fellows who are diplomates in the low vision section; 3 fellows who are diplomates in the anterior segment section; 84 fellows who are diplomates in the cornea, contact lens, and refractive tech section, and 3 fellows who are diplomates in the glaucoma section (https://www.aaopt.org/).

2) Low vision rehabilitation professionals – This group consists of Certified Low Vision Therapists (CLVT), Certified Vision Rehabilitation Therapists (CVRT), Certified Orientation and Mobility Specialists (COMS), vocational rehabilitation professionals, and occupational therapists with specialty certification in low vision (SCLV). The Academy for Certification of Vision Rehabilitation & Education Professionals (ACVREP) website (www.acvrep.org) reports that there are approximately 482 professionals currently certified as low vision therapists, 2,840 professionals currently certified as orientation and mobility specialists, and 662 professionals

currently certified as vision rehabilitation therapists. According to the American Foundation for the Blind (2018), there are more than 4 million people that are of working age in the United States who report some form of visual impairment; these people often need some specialized employment services to maintain their chances to obtain gainful employment, remain employed, and advance in the workplace. Any specialized employment services are provided by either state or private rehabilitation agencies. Vocational rehabilitation counselors provide case management, referral services, and guidance and counseling services through state vocational agencies. Despite each state having a vocational rehabilitation agency with vocational rehabilitation counselors that serve people who are blind and visually impaired, there are no statistical estimates that report how many total vocational rehabilitation counselors work in these agencies. The American Occupational Therapy Association's website (www.aota.org) lists 58 occupational therapists who have a SCLV.

3) People with moderate to near total vision impairment – This group of people consists of people who have moderate to near total vision impairment; that is, these individuals have a visual acuity of $\leq$ 20/60, or central visual field $\leq$ 20 degrees. The 2015 National Health Interview Survey conducted by the Centers for Disease Control (CDC) (2015) estimates that there are 23.7 million American adults aged 18 and older that report having trouble seeing, even when wearing glasses or contact lenses, or report that they are blind or unable to see at all. The American Council of the Blind (ACB) estimated that

this survey had the potential to reach an estimated 10,000 people who are blind or have a vision impairment (C. Rachfal, personal communication, April 3, 2020).

Convenience sampling was used to recruit members of the target population. Polit & Beck (2012) and Etikan et al. (2016) recommended the use of convenience sampling when the target population is finite which means participants do not have an equal chance of being recruited for the study. Rowley (2014) states that this type of sampling is often used in pilot studies because it allows the researcher to obtain basic data and trends when the sampling frame is not clear or complete, and/or the participant response rate is low. Acharya et al. (2013) added that this type of nonprobability sampling is commonly used in social science and health-related research because subjects are recruited based on whether they meet the inclusion criteria of the study. Some advantages of convenience sampling are that it is cost effective, easy to perform, and uses simple practical criteria to guide subject recruitment, such as easy accessibility, geographical proximity, availability at a given time, and willingness to participate (Etikan et al., 2016).

One limitation or disadvantage of convenience sampling is the lack of variability in the elements, traits, or characteristics of the sample, which may not accurately represent the entire population (Acharya et al., 2013; Etikan et al., 2016). This is problematic because the recruited participants may not fit the research problem, and the lack of variability in the sample's characteristics may result in collecting poor quality data. Polit & Beck (2012) suggest that one way to increase sample variability and, thus, generalizability is to recruit subjects from multiple sources. Another limitation or disadvantage of convenience sampling is selection bias – a common problem in nonprobability sampling – which is due to who volunteers to participate in the study (Acharya et al., 2013; Etikan et al., 2016; Polit & Beck, 2012). This becomes an issue when those who choose to respond have different characteristics than those who choose not to respond, resulting in outliers, or cases that do not fit with the data (Etikan et al., 2016). Etikan et al. (2016) state that selection bias can be addressed by identifying how the convenience sample would differ from a random sample, which includes describing the participants who may be excluded during the selection process and which subjects are overrepresented in the sample. Additionally, Polit & Beck (2012) recommend the use of oversampling each group in the sample in order to mitigate the effects of selection bias.

Sample Size and Description

According to Johanson and Brooks (2010), "determining the sample size needed to detect a particular effect given the level of significance and desired power for the statistical analyses" is less straightforward for pilot and feasibility studies as well as survey and instrument development" (p. 395). Despite being more difficult to accurately estimate sample size in these cases, they add that determining an appropriate sample size is necessary for adequate precision and statistical power prior to data collection, especially when estimating population parameters or testing null hypotheses. Since the investigation of participants' behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option is a new area of research, not enough data or evidence is available to statistically determine the appropriate sample size needed to develop and validate a survey. Therefore, the literature was reviewed for recommendations on what is the appropriate sample size for a survey pilot study.

Hill (1998) addressed the topic of the sample size needed for internet survey research which requires balancing the economy and convenience of small samples and the reliability and representativeness of large samples. He recommended a sample size of 10 to 30 participants per group for exploratory research and pilot studies because this sample size was “large enough to test the null hypothesis and small enough to overlook weak treatment effects” (p. 7). He does caution that this small of a sample size probably will not show statistical significance.

Julious (2005) also provided guidance on the sample size required for clinical trial pilot studies, He concluded that a sample size of 12 per group provided sufficient information to use for future larger scale studies, especially when no prior data exists to base a sample size on. His main reason for suggesting this sample size was primarily centered around the sample’s gains in precision about both the mean and the variance becoming less pronounced after a sample size of 12 was reached, In addition to statistical precision, feasibility and regulatory concerns were two other reasons he used to justify this sample size for clinical trial pilot studies.

A third article recommended creating and using confidence intervals to help determine a reasonable lower limit of sample sizes necessary for pilot studies that serve a variety of purposes (Hertzog, 2008). For each type of pilot study, Hertzog (2008) used a hypothetical sample size of 10 – 40 participants per group. The lower end of this sample size continuum (i.e., 10) “represents 10% of the typical size of a fully powered clinical trial comparing an intervention with a control group” while the upper end of this sample size continuum (i.e., 40) “was chosen based on experience that a pilot study of more than 40 per group is likely to be unrealistic in terms of time and cost, and, in some cases, would not be an optimal use of a limited sample of participants available for a study” (p. 181). She also mentions that the usual 95% confidence interval may be too stringent for a pilot study due to its exploratory nature and sample size limitations, so she also provided data for more liberal confidence intervals of 68% and 90%. For feasibility pilot studies (i.e., studies that seek to identify and correct issues related to initiating an intervention), Hertzog (2008) found that to calculate, for instance, a 15% patient adherence rate to a given intervention in a pilot study with 20 subjects one could be 90% confident that the estimate is accurate within 13 percentage points. If the sample size is doubled to 40 participants then one can be 90% confident that the estimate is accurate within 9 percentage points. However, if the sample size was increased to 80 subjects then there is only a modest gain of the estimate accuracy by 2 percentage points; that is, with a sample size of 80 participants one could be 90% confident that the estimate is accurate within 7 percentage points. In some cases, Hertzog (2008) reasons that a researcher may need the small increase in estimation precision of 2 percentage points when increasing the sample size from 40 to 80 subjects, such as ensuring the data of a smaller study is precise as possible to adequately guide the power analysis for a future larger study. In other cases, an accuracy estimation between 10 to 15 percentage points is sufficient, like evaluating participants adherence to a new protocol to identify any issues that may lead to modifying an intervention.

Adequacy of instrumentation was another type of pilot study addressed by Hertzog (2008). She states that a sample size of 10 is adequate if the objective of the pilot study is to evaluate the wording of items, clarity of instructions, formatting of the instrument, or ease of administering the instrument. However, a sample size of 10 would not be sufficient to estimate test performance (e.g., internal consistency and test–retest reliability), assess item performance, or revise an instrument, For test-retest reliability, or correlating the scores of two separate test administrations for the same instrument, an observed correlation of, at least, .70 means the instrument is stable, but, for established instruments, a correlation of .80 is preferable – these estimates, though, can depend on the length of time between test administrations.

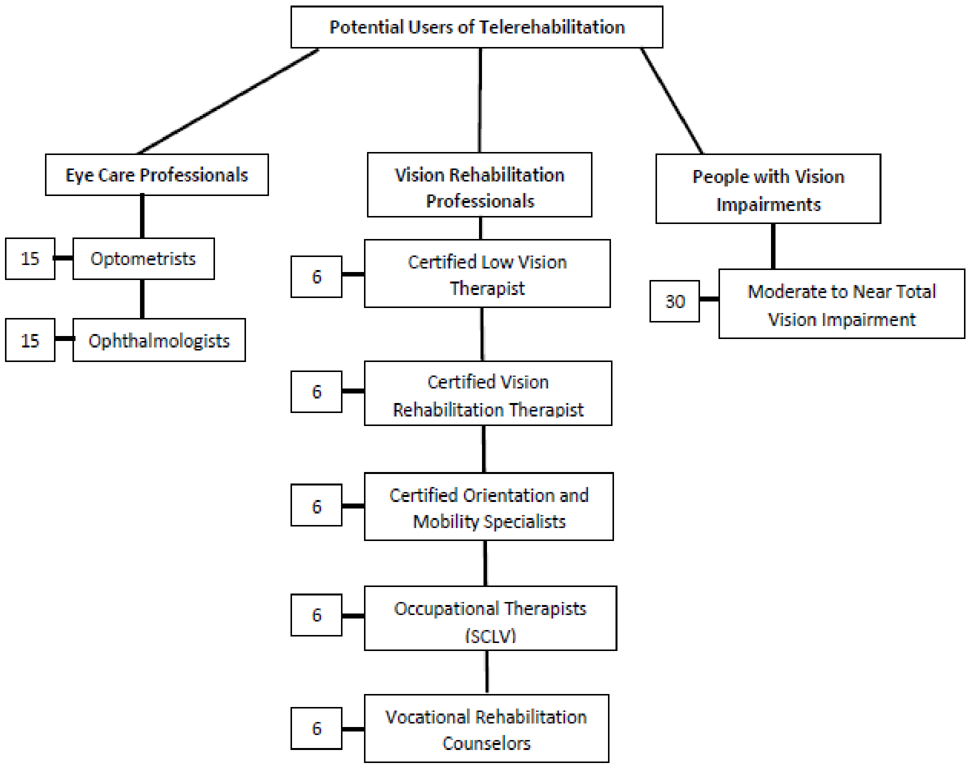
Hertzog (2008) found that for a correlation of .80 and a confidence interval of 90% a sample size of 50 (25 subjects per group) would have a confidence interval spread of 17 points (.70 - .87), and a sample size of 60 (30 subjects per group) would have a confidence interval spread of 16 points (.71 - .87), and a sample size of 70 (35 subjects per group) would have a confidence interval spread of 14 points (.72 - .86). As one can see, the gains of precision in the confidence interval spread (i.e., 3 points) are relatively minor as the sample size increases from 50 to 70 participants. For internal consistency of pilot studies, data are used to determine if an instrument is either consistent with reported values or able to be used with a specific population. Hertzog (2008) concluded that for a Cronbach's alpha of .80 and a confidence interval of .90 a sample size of 30 (15 subjects per group) would have a confidence interval of 18 points (.70 - .88), a sample size of 40 (20 subjects per group) would have a confidence interval of 15 points (.72 - .87), and a sample size of 50 (25 subjects per group) would have a confidence interval of 13 points (.73 - .86), and, finally, a sample size of 60 (30 subjects per group) would have a confidence interval of 13 points (.73 - .86). Like the results for test-retest reliability, the gains in precision of confidence interval spread (i.e., 2 points) are minimal as the sample size increases from 40 to 50 participants. Lastly, for item performance, item-total correlations are utilized as an indicator of the ability of an item to represent performance for the total instrument which should be interpreted within the context of the construct being measured; that is, item-total correlations are higher for narrowly defined constructs, and lower for broadly defined constructs. The minimum acceptable level of item-total correlations is .30. and compared to values of the index observed for other items on the same scale, .30 is often suggested as a minimum acceptable level. Hertzog (2008) noted that the item-total correlation estimates are quite imprecise at a level of .30 due to the width of the confidence intervals, even at the more liberal 68% confidence interval. Thus, she does not recommend making final decisions on including or excluding items based on this criterion, especially when using pilot data.

The last type of pilot study discussed by Hertzog (2008) is planning for a larger study. In some cases, a researcher will utilize information, like judgments of clinical importance and effect size estimates, from previous literature to conduct a power analysis for a larger study. However, these estimates are only valuable (i.e., predicting whether a specific intervention will produce an effect of a certain size) if the previous studies use the same design, methods, and procedures that a researcher is planning to utilize for a larger study. In other cases, no prior data is available to conduct a power analysis and estimate the effect size of an intervention, so pilot studies are used to provide the needed data. Since small sample sizes have been found to be positively biased (i.e., effect sizes are overestimated) and imprecise, Hertzog (2008) recommends that, in practice, a researcher should estimate confidence interval limits around a bias corrected effect size. After correcting for bias, she found that a moderate effect size had only small confidence interval improvements when the sample size went from 20 subjects per group (i.e., .00 - .11) to 40 subjects per group (i.e., .01 - .11). A greater confidence interval improvement in effect size was noted for a large effect size (i.e., .14) when the sample size doubled from 20 participants per group (i.e., .03 - .21) to 40 participants per group (i.e., .06 - .20). In addition to these values, Hertzog (2008) also warns that if a researcher is attempting to use a pilot study to estimate effect sizes then a small sample size between 20 – 80 participants can only provide a rough estimate, including estimates for large observed effect sizes.

The last article reviewed specifically discusses the importance pilot studies play in developing a new instrument or revising an existing one, especially when a researcher needs to confirm that the instrument utilizes clear and appropriate language, contains no blatant errors or omissions, and possesses sufficient psychometric properties prior to its use (Johanson & Brooks, 2010). They also mention that pilot studies are useful in estimating response rate, investigating the feasibility of a study, and testing null hypotheses. In order for pilot studies to accomplish these tasks - especially estimating parameters and testing null hypotheses - with precision and statistical power, they must have an adequate sample size. However, determining the necessary sample size for a pilot study is more difficult than estimating the sample size required to achieve a specific effect size, based on a desired level of significance and power, for a larger study because of many factors, like accurately representing the population and properly controlling for bias. Therefore, when making a pilot study sample size recommendation for preliminary survey or instrument development Johanson and Brooks (2010) used a cost-benefit analysis approach, or, in other words, getting the most information with the smallest cost. Like Hill (1998) and Julious (2005), they found the point where an increase in sample size resulted in a smaller effect in predicting important population parameters. In all cases (i.e., measuring item discrimination, estimating response rates, determining the proportion of respondents selecting a specific option for an item, and finding a survey's internal consistency), they concluded that as the sample size increased from 24 - 30 participants to 30 – 36 participants there was only a minimal gain in precision as well as a loss of impact on the confidence interval spread. Although Johanson and Brooks' (2010) admit sample size recommendations depend largely on the purpose of the pilot study and that larger sample sizes are consistently better than smaller ones because the precision of population parameter estimates increase as sample size increases, they recommend that a minimum sample size of 30 representative subjects from the population of interest for a preliminary survey or instrument development pilot study.

According to the above recommendations from Hill (1998), Julious (2005), Hertzog (2008), and Johanson and Brooks (2010), a minimum sample size of 30 participants that is representative of the population being observed or researched is necessary for exploratory pilot studies that involve preliminary survey development. Since this study sampled from three separate and distinct populations (i.e., eye care professionals, low vision rehabilitation professionals, and people with moderate to near total vision impairment), the researcher attempted to recruit a minimum of 90 subjects, or 30 subjects per participant group. Figure 8 depicts how this minimum sample size estimate was distributed among the user groups. The researcher attempted to recruit a minimum of 30 eye care professionals that consisted of 15 optometrists that are Fellows of the American Academy of Optometry and 15 board certified ophthalmologists; the researcher also attempted to recruit a minimum of 30 low vision rehabilitation professionals. This includes 6 Certified Low Vision Therapists, 6 Certified Vision Rehabilitation Therapists, 6 Certified Orientation and Mobility Specialists, 6 occupational therapists with a specialty certification in low vision, and 6 vocational rehabilitation counselors that work with people who have moderate to near total vision impairments. Lastly, the researcher attempted to recruit a minimum of 30 people with moderate to near total vision impairments.

Figure 8: Potential Users of Telerehabilitation



Inclusion Criteria

The inclusion criteria for eye care professionals were as follows: (1) ophthalmologist or optometrist that practices at least part time in the United States; (2) licensed or registered as an MD or Doctor of Optometry in the state they practice; (3) actively treat people who have moderate to near total vision impairments; (4) ophthalmologists must be certified by the American Board of Ophthalmology; (5)

optometrists must be fellows of the American Academy of Optometry; and (6) adults 18 years of age or older.

The inclusion criteria for low vision rehabilitation professionals were as follows: (1) they must practice at least part time in the United States; (2) actively work with people who have moderate to near total vision impairments; (3) Certified Low Vision Therapists (CLVT), Certified Vision Rehabilitation Therapists (CVRT), and Certified Orientation and Mobility Specialists must be currently certified by the Academy for Certification of Vision Rehabilitation & Education Professionals (ACVREP); (4) vocational rehabilitation counselors must work for a state agency or division that serves clients with moderate to near total vision impairments; (5) occupational therapists must be licensed as occupational therapists in the state they practice, and must have a specialty certification in low vision from the American Occupational Therapy Association (AOTA); and (6) adults 18 years of age or older.

The inclusion criteria for participants with vision impairments included the following: (1) live at least part time in the United States; (2) adults 18 years of age or older; and (3) self-report eye condition/disease that results in a moderate to near total vision impairment. Self-report of vision condition and level of vision impairment is supported by the literature as a feasible and accurate method of collecting this type of information (Cumberland, Chianca, & Rahi, 2016; Whillans & Nazroo, 2014). Cumberland et al. (2016) performed a cross sectional epidemiological study of 107,409 participants who were between 40 to 69 years old. Participants' vision was measured using autorefraction – a gold standard in visual acuity measures - to determine if they had myopia. They were also asked to self-report if they were prescribed glasses and/or contact lenses and why they were prescribed glasses and/or contact lenses. Those who reported needing optical correction for myopia had a sensitivity of 89.1% with a 95% confidence interval of 88.7% - 89.4%, and a specificity of 83.7% with a 95% confidence interval of 83.4%-84.0%. Whillans and Nazroo (2014) utilized data from The Irish Longitudinal Study on Ageing (TILDA) to investigate the relationship between self-reported vision and a direct measure of visual acuity using the logarithm of the Minimal Angle of Resolution (logMAR). The results found that participants with an eye condition (21.03%) and those having undergone cataract surgery (14.83%) were statistically more likely to self-report a vision impairment than participants with no eye condition (6.96%) or treatment (8.73%). Logistic regression of the data revealed that wearing glasses (0.766, $p < .05$) and having an eye condition (4.416, $p < .001$) were predictors of self-reported vision impairments. Self-reported fair vision (4.021, $p < .001$) and poor vision or blindness (16.934, $p < .001$) were also found to be predictors of having low visual acuity. Based on these findings, Whillans and Nazroo (2014) concluded that subjective self-report of vision impairment and measured visual acuity impairment are significantly associated with one another, and that self-report of vison impairment is a significant predictor of measured low visual acuity in older people,

Sample Recruitment

Recruitment of potential participants occurred through one of the following methods: (1) the researcher's Virginia Commonwealth University email; (2) general announcements posted to eye care professional listservs, vision rehabilitation professional listservs, and people with vision impairment listservs; (3) general announcements sent to moderators or producers of podcasts and YouTube channels that target one of the three target groups; and (4) the researcher's Virginia Commonwealth University Facebook, LinkedIn, Instagram, and Twitter accounts. All emails and announcements that were sent out to recruit potential participants asked the recipients to "please feel free to share this link with any of the following people: people with vision impairments, ophthalmologists, optometrists, low vision therapists, rehabilitation counselors, orientation and mobility specialists, occupational therapists, and vision rehabilitation therapists." This recipient referral was another source of recruitment for potential participants

Recruitment Via Email

An email message was sent to potential participants in the eye care and vision rehabilitation professional groups from the researcher's Virginia Commonwealth University email address (Appendix #4). The email identified that the research was being conducted as PhD dissertation work at Virginia Commonwealth University and contained the following information: (a) a brief introduction to the study, including a request for participants' assistance; (b) an explanation that participation will provide useful information for developing and implementing an option to provide low vision rehabilitation services through telerehabilitation as a complement to face-to-face rehabilitation; (c) a web URL link to the Qualtrics survey; (d) an approximate time that it would take to complete the survey; (e) a statement that participants' information would be kept confidential and participation in the survey is voluntary; (f) verbal appreciation for their participation; and (g) the researcher's contact information.

Once responders clicked on the web URL link in the email, they were taken to an introductory portion of the survey that allowed participants to verify the authenticity of the survey (see Appendix #1). This introductory portion of the survey also provided a brief explanation of the purpose of the survey, stated approximately how much time it would take to complete the survey, gave directions for completing the survey, and reassured participants that their information would be kept confidential and that survey participation was voluntary, and listed contact information of the researcher if the participants had any comments or questions. The participants were then informed that by proceeding with the survey they were consenting to participate in the survey. After completing the survey, participants were taken to a closing screen that thanked them for their time and participation and provided participants with the researcher's contact information if they wanted a copy of the results when the survey was finished.

Private email messages were sent to recruit potential participants in the eye care professional and vision rehabilitation groups who have made their email addresses public on their professional organization website. Email addresses for eye care professionals were obtained from the following professional organization websites: American Academy of Ophthalmology, American Board of Ophthalmology, American College of Eye Surgeons, American Glaucoma Society, American Ophthalmological Society, American Society of Cataract & Refractive Surgery, American Society of Retina Specialists, Association for Research in Vision and Ophthalmology, Foundation Fighting Blindness, Research to Prevent Blindness, American Academy of Optometry, American Optometric Association, and American Optometric Foundation. Vision rehabilitation professionals' email addresses were obtained from the following professional organization websites: Academy for Certification of Vision Rehabilitation & Education, Association of Vision Rehabilitation Therapists, and American Occupational Therapy

Association. Potential participants in both groups were also recruited via email to state or private clinics or agencies (see Appendix #5).

Recruitment Via General Announcement

A general announcement was distributed to various organizations and groups to recruit potential participants (see Appendix #6). Potential participants from the eye care professional group were recruited by sending a general announcement to private clinics or agencies where eye care professionals work; eye care professional listservs; eye care professional organizations (i.e., American Academy of Ophthalmology, American Board of Ophthalmology, American College of Eye Surgeons, American Glaucoma Society, American Ophthalmological Society, American Society of Cataract & Refractive Surgery, American Society of Retina Specialists, Association for Research in Vision and Ophthalmology, Foundation Fighting Blindness, Research to Prevent Blindness, American Academy of Optometry, American Optometric Association, and American Optometric Foundation); and Facebook, LinkedIn, Instagram, and Twitter social media groups that target eye care professionals.

Recruitment of potential participants from the vision rehabilitation professional group was accomplished by sending a general announcement to private clinics or agencies where vision rehabilitation professionals work; vision rehabilitation professional listservs; vision rehabilitation professional organizations (i.e., Academy for Certification of Vision Rehabilitation & Education and American Occupational Therapy Association); and Facebook, LinkedIn, Instagram, and Twitter social media groups that target vision rehabilitation professionals (see Appendix #6).

People with vision impairments were recruited by sending a general announcement to state and private agencies that serve people with vision impairments; organizations that advocate for people that are visually impaired (i.e., the National Federation of the Blind (NFB), American Council of the Blind (ACB), and American Foundation of the Blind (AFB)); listservs that target people with vision impairments; and Facebook, LinkedIn, Instagram, and Twitter social media groups whose members are people with vision impairments.

General announcements for this study were sent to state and private agencies that serve people with vision impairments, professional organizations, listservs, and social media groups (Facebook, LinkedIn, Instagram, and Twitter) from either the researcher's Virginia Commonwealth University email address, or from one of the researcher's dedicated Virginia Commonwealth University Facebook, LinkedIn, Instagram, or Twitter accounts. The general announcement identified that the research was conducted as PhD dissertation work at Virginia Commonwealth University and contained the following information: (a) a brief introduction to the study, including a request for participants' assistance; (b) an explanation that participation provides useful information for developing and implementing an option to provide low vision rehabilitation services through telerehabilitation as a complement to face-to-face rehabilitation; (c) a web URL link to the Qualtrics survey; (d) an approximate time the survey takes to complete; (e) a statement that participants' information is kept confidential and participation in the survey is voluntary; (f) verbal appreciation for their participation; and (g) the researcher's contact information. Any follow up general announcements contained the same information as the original general announcement with the addition of how many people have responded to the survey.

Once responders clicked on the web URL link in the general announcement, they were taken to an introductory portion of the survey that allowed participants to verify the authenticity of the survey. This introductory portion of the survey also provided a brief explanation of the purpose of the survey, stated approximately how much time the survey would take to complete, gave directions for completing the survey, and reassured participants that their information would be kept confidential and that survey participation is voluntary, and listed contact information of the researcher if they have any comments or questions. The participants were then informed that by proceeding with the survey they were consenting to participate in the survey. After completing the survey, participants were taken to a closing screen that thanked them for their time and participation, and provided participants with the researcher's contact information if they wanted a copy of the results when the survey was finished.

Recruitment Via Social Media

Social media recruitment of potential participants occurred through the researcher’s dedicated Virginia Commonwealth University Facebook, LinkedIn, and Instagram social media accounts. Each of the researcher’s social media accounts specifically identified: (a) the researcher as a PhD student at Virginia Commonwealth University (VCU); (b) the researcher’s VCU affiliated email; (c) the researcher’s other contact information; and (d) the researcher’s biographical statement The biographical statement was shortened when necessary for some of the researcher’s social media accounts due to word count limitations (see Appendix #7).

Eye care professionals were recruited by performing a search on Facebook, LinkedIn, and Instagram using the following keywords: optometry, ophthalmology, and eye care professional. These keyword searches were used to find individuals that are eye care professionals and groups whose members are made up of eye care professionals. For individuals that are eye care professionals, the researcher sent the "Social Media/General Recruitment Announcement" in a private message (Appendix #6). For social media groups with members who are eye care professionals, a "Social Media/General Recruitment Announcement" was sent to the group owner or moderator. The message requested that the group owner or moderator post the announcement on the group's page.

Recruitment of potential participants that are vision rehabilitation professionals through social media occurred through the researcher's dedicated Virginia Commonwealth University Facebook, LinkedIn, and Instagram social media accounts. Recruitment for this group began by performing a search on Facebook, LinkedIn, and Instagram using the following keywords and acronyms: certified low vision therapist, CLVT, certified vision rehabilitation therapist, CVRT, certified orientation and mobility specialist, COMS, vocational rehabilitation professional, and occupational therapists with specialty certification in low vision, SCLV. These keyword and acronym searches were used to find individuals that are vision rehabilitation professionals as well as groups whose members are made up of vision rehabilitation professionals. For individuals that are vision rehabilitation professionals, the researcher sent the "Social Media/General Recruitment Announcement" in a private message. For groups, whose members are vision rehabilitation professionals, a "Social Media/General Recruitment

Announcement" was sent to the group owner or moderator. The message requested that the group owner or moderator post the announcement on the group's page.

The last group that was recruited through the researcher's dedicated Virginia Commonwealth University Facebook, LinkedIn, and Instagram social media accounts was people with vision impairments. Recruitment for this group began by performing a search on Facebook, LinkedIn, and Instagram using the following keywords: low vision, vision impairment, blind, partially blind, and partially sighted. These keyword searches were used to locate groups whose members are made up of people with vision impairments. For groups, whose members are people with vision impairments, a "Social Media/General Recruitment Announcement" was sent to the group owner or moderator. The message requested that the group owner or moderator post the announcement on the group's page.

The "Social Media/General Recruitment Announcement" identified that the research is being conducted as PhD dissertation work at by Virginia Commonwealth University and contained the following information: (a) a brief introduction to the study, including a request for participants' assistance; (b) an explanation that participation provides useful information for developing and implementing an option to provide low vision rehabilitation services through telerehabilitation as a complement to face-to-face rehabilitation; (c) a web URL link to the Qualtrics survey; (d) an approximate time the survey takes to complete; (e) a statement that participants' information is kept confidential and participation in the survey is voluntary; (f) verbal appreciation for their participation; and (g) the researcher's contact information. Any follow up announcements contained the same information as the original announcement with the addition of how many people have responded to the survey.

Once responders clicked on the web URL link in the “Social Media/General Recruitment Announcement,” they were taken to an introductory portion of the survey that allowed participants to verify the authenticity of the survey (see Appendix #1). This introductory portion of the survey also provided a brief explanation of the purpose of the survey, stated approximately how much time the survey would take to complete, gave directions for completing the survey, and reassured participants that their information would be kept confidential and that survey participation is voluntary, and listed contact information of the researcher if they have any comments or questions. The participants were then informed that by proceeding with the survey they consented to participate in the survey. After completing the survey, participants were taken to a closing screen that thanked them for their time and participation, and provided participants with the researcher's contact information if they wanted a copy of the results when the survey was finished.

Survey

Survey Development

Data collection for this study utilized survey methods derived primarily from an instrument developed by Venkatesh et al. (2003) and adapted by Liu, et al. (2015) and Hoque and Sorwar (2017) to investigate technology acceptance and use, as discussed in Chapter Two. Survey questions addressed the following constructs: performance expectancy, effort expectancy, technology anxiety, and resistance to change. The survey questions were modified to relate to the potential users in the survey’s intended target populations, the specific technology addressed by this survey (i.e., telerehabilitation), and the dependent variable (i.e., behavioral intention to accept and use telerehabilitation). The 7-point Likert rating scale used in the original UTAUT survey was retained in an effort to assure similar reliability, validity, and model fit statistics from previous uses of the instrument (Venkatesh et al., 2003); and others who used versions of the survey (Im et al., 2011; Liu et al., 2015; Moran et al., 2010; Wang et al., 2009). However, if the model fit statistics for this survey were judged unfavorable then some of the rating scale categories could be collapsed to a 5-point Likert scale. Psychometric properties of the survey were not significantly impacted when other studies made this adjustment (Hoque and Sorwar, 2017; Abdekhoda et al., 2016; Phichitchaisopai & Naenna, 2013; Kim et al., 2016).

Administration

Survey questions were uploaded into Qualtrics, a cloud-based survey tool that allows participants to respond through the digital device that is most convenient for them (i.e., computer, tablet, and mobile phone) (Qualtrics, 2021a). Qualtrics' Information Security Management System (ISMS) is authorized by the Federal Risk and Authorization Management Program (FedRAMP) which is a federal government initiative consisting of more than 300 policies and procedures that evaluates, approves, and monitors web-based software providers and protects the confidential data stored in federal agencies (Qualtrics, 2021b). This survey tool conforms with the international data security standards created by the International Organization for Standardization (ISO) and is ISO 27001 certified. Qualtrics is also compliant with the Health Insurance Portability Accountability Act (HIPAA) security requirements and has a cybersecurity framework certification from the Health Information Trust Alliance (HITRUST). Additionally, Qualtrics provides accessibility features that allow people with vision impairments to easily interface with the application by using assistive technology software, such as screen readers and magnifiers. Specifically, the application was designed to support data capture for research studies by providing an intuitive interface for validated data entry, allowing data manipulation and export procedures to be tracked through audit trails, permitting downloads to common statistical packages by automated export procedures, and supplying procedures to import data from external sources. This survey tool is used by over 11,000 brands and 99 out of the top 100 business schools (Qualtrics, 2021c).

The use of web-based surveys is on the rise in healthcare research (McPeake et al., 2014). Several advantages of web-based surveys are low administration costs; ease of data analysis; reduction of time and resources needed for survey administration, collection, and analysis; access to people at great distances; and decrease in the chance of human error (McPeake et al., 2014; Wright, 2005). One major challenge posed by web-based surveys is selection bias due to the survey not being appropriate for many groups of participants. This challenge has been controlled for by oversampling each group of participants and recruiting subjects from multiple sources as suggested by Polit and Beck (2012). Survey distribution difficulties may include outdated and inaccurate email addresses, or participants having multiple email accounts that they rarely check. The accuracy of participants' email addresses was verified through an organizational website search, especially for emails that were returned undeliverable. A third major challenge of web-based surveys is decreased response rates that are caused by the population being surveyed, unfamiliarity with the web, inconsistent or unreliable internet access, and participants' wariness of sending confidential information over the internet. Several ways this study addressed these challenges were as follows: (1) minimizing the length of the survey as much as possible; (2) placing the estimated time to complete the survey in the introductory email; (3) sending up to 3 reminder emails to participants; (4) including the current response rate in each reminder email; and (5) embedding the link of the survey directly into the body of the invitation email.

Dillman et al. (2014) provide some general guidelines to visually enhance surveys to ensure they are easily accessible, user friendly, and encourage higher response rates. One guideline is to use darker and lighter print to help participants to easily differentiate between the item and its answer choices. A second guideline is to visually standardize spacing and response options within and between items. Thirdly, surveys should visually enhance elements that are important to the respondent and deemphasize the elements that are not important, especially when an item has special instructions that need to be followed (e.g., "if you answer no to this item skip to item #9"). A fourth guideline is to choose a font, font size, and line length to ensure the legibility of the text. Specifically, these authors recommend using a sans serif font, a 10- to 12-point font size, and a moderate line (i.e., item) length of three to five inches. Additional considerations for font and font size were needed for this survey to accommodate participants' who use assistive technology, like screen readers and magnifiers. Therefore, this survey used an Arial 12-point font, which is a common font installed on most computers that would easily interface with assistive technology programs. Lastly, red and green font colors were avoided in this survey to ensure participants who are color blind can read the survey (see Appendix #1).

Survey Design

According to Dillman et al. (2014), survey design is a three-phase process. The first phase of the process is pretesting, or expert review, which consists of utilizing a systematic approach to obtain feedback on the draft questionnaire from content, questionnaire, and analysis experts. This phase involves evaluations from people with technical knowledge that can identify potential problems with the survey questions and the questionnaire itself. They provide the following recommendations for selecting appropriate experts: (1) use more than one expert to evaluate the survey items and questionnaire to obtain a wide variety of viewpoints on potential problems; (2) choose a wide variety of experts with technical knowledge on the survey topic, how data – including demographics – are collected in comparison surveys, statistical analysis techniques, survey mode effects, questionnaire design, and characteristics of the population to be surveyed; and (3) avoid limiting survey pretesting to colleagues in the same department, or to experts who are members of the study population. This study used 5 experts for the pretesting phase of this survey design: one expert, Albert E. Copolillo, Ph.D., OTR/L, FAOTA, was a professional that works with people who have moderate to near total vision impairments and provided technical knowledge in the content area of vision rehabilitation; one expert, Ronald T. Cenfetelli, PhD, was a professional that possesses technical knowledge in the content area of technology acceptance and use; one expert, Henry Carretta, PhD, was a professional with technical knowledge in the content area of data analysis; one expert, James M. Ellis, Jr., Ph.D, was a professional that has technical knowledge in the content area of survey design; and one expert, Carolyn Wilken, PhD, was a person with a vision impairment who has technical knowledge in the content area of using assistive technology to access web-based content. These experts' implementation opinions and advice were used to establish the survey's face and content validity as well as to adjust the survey prior to pilot testing the full survey.

The second phase of survey design involves performing a small pilot study with a subsample of the population to evaluate the survey and identify potential problems (Dillman et al., 2014). The objective of this phase is to ascertain whether the proposed survey and procedures are adequate for a larger study. Some valuable information that can be collected during this phase about the survey and its items include how individual items are performing, how the overall design of the survey is working, how well items discriminate based on response rates and distributions, and how easily respondents can follow the instructions. Pilot testing will also provide important answers to the following questions related to the survey design procedures: (1) how well will participants react to the contacts and any material provided; (2) what proportion of the sample will answer the survey; (3) what problems or areas of confusion will arise; (4) are only certain types of people responding to the survey which can impact response error; (5) how well has the survey been implemented by the researcher; (6) how much time is needed for each step in the process; and (7) is the system adequately tracking and monitoring progress. The researcher will then utilize the collected information regarding the survey and its procedures to resolve any issues that could be problematic, ineffective, or inefficient prior to implementing the larger study.

Although pilot testing can be time consuming and tax already limited resources, Dillman et al. (2014) suggests that "even a study with a small sample size will allow for the full survey procedures to be tested from start to end" which will save on a researcher's time and resources in the long run (p. 252). The purpose of this study is to pilot test a survey used to collect data on the behavioral intention of key stakeholders to accept and use telerehabilitation as a low vision rehabilitation service delivery option. Therefore, this study attempted to recruit 30 participants from each stakeholder group for a total sample size of 90 participants. Convenience sampling was performed to attempt to recruit 30 eye care professionals, 30 low vision rehabilitation professionals, and 30 people with moderate to near total vision impairments. After receiving Virginia Commonwealth University (VCU) Institutional Review Board (IRB) approval the survey was administered to this sample through the Qualtrics cloud-based application (Qualtrics, 2021a). Data collected from this subsample was uploaded into the Statistical Package for Social Sciences (IBM SPSS v. 22) which provided composite reliability, internal consistency reliability, convergent validity, and discriminate validity. These results will then be used to make further adjustments or modifications to the survey for use in future larger sample size research projects.

The third phase of survey design is administration of the finalized survey to a larger sample. This phase is out of the current study's scope. However, future larger sample size projects investigating behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option could utilize the results of this pilot study to verify composite reliability, internal consistency reliability, convergent validity, discriminate validity, model fit statistics, and model statistics. These statistics will also validate which factors are significant predictors of behavioral intention to accept and use telerehabilitation as a low vision service delivery option.

Reliability

Two types of reliability (i.e., how closely the items are related to each other) were measured using the Statistical Package for Social Sciences (IBM SPSS v. 22). The first type of reliability evaluated in this study's model is internal consistency reliability which was measured by Cronbach's alpha (Cronbach, 1951). The second type of reliability evaluated in this study was construct reliability which was also measured by Cronbach's alpha. According to Nunnally (1978), a Cronbach's alpha greater than or equal to 0.9 is excellent, a Cronbach's alpha between 0.8 and 0.9 is good, a Cronbach's alpha between 0.7 and 0.8 is acceptable, a Cronbach's alpha between 0.6 and 0.7 is questionable, a Cronbach's alpha between 0.5 and 0.6 is poor, and a Cronbach's alpha less than 0.5 is unacceptable.

Measurement Validity

Face Validity. Face validity of a survey or questionnaire is established when the survey appears to measure what it is supposed to measure (Polit & Beck, 2012). This study's survey was designed using constructs and items from previously published surveys and questionnaires that have established face validity (i.e., Hoque and Sorwar, 2017; Liu et al., 2015; Venkatesh et al., 2003). For this study, face validity was established through pretesting the survey with a group of five experts.

Content Validity. Polit and Beck (2012) describe content validity as the extent to which the survey or questionnaire has a sufficient number of items to adequately represent the construct being measured. This study ensured adequate content validity of the survey by pretesting it with a group of five experts and by aligning the survey items with the study's constructs (see Table 4).

Table 4: Content and Construct Validity: Aligning the Survey Questions (Q) with the Survey Constructs

Category/Construct	Survey Questions								
	Q1	Q2 – Q11	Q12 – Q48	Q49 – Q51	Q52 – Q56	Q57 – Q61	Q62 – Q66	Q67 – Q79	Q80 – Q90
Demographics	X		X						
Inclusion Criteria		X							
Behavioral Intention				X					
Performance Expectancy					X				
Effort Expectancy						X			
Technology Anxiety							X		
Resistance to Change								X	
Technology Comfort									X
Hypothesis 1				X	X	X	X	X	
Hypothesis 2				X	X				
Hypothesis 3				X		X			
Hypothesis 4				X			X		
Hypothesis 5				X				X	

Construct Validity. Construct validity, or the extent to which a survey or questionnaire measures the constructs under investigation, is comprised of two types of validity (i.e., convergent validity and discriminant validity) that were measured by the Statistical Package for Social Sciences (IBM SPSS v. 22). Convergent validity was measured by the average variance extracted (AVE) numbers. AVE values of .50 or higher is preferred. Discriminant validity was evaluated by the AVE and latent variable correlations, and was established when the square root of AVE of each construct was greater than the correlations among the constructs.

Model Statistics

The questions in the survey that represent the predictor variables (i.e., performance expectancy, effort expectancy, technology anxiety, and resistance to change) and the outcome variable (i.e., behavioral intention) use Likert-scale items which produce ordinal scale data (Ferguson, 2009). Traditionally, nonparametric tests (e.g., Spearman rho) have been recommended for analyzing ordinal data, however, Norman (2010) suggests that parametric tests (e.g., Pearson correlation coefficient) can not only be used to analyze ordinal data but are generally more robust than nonparametric tests to violations of statistical assumptions. In other words, Norman (2010) states that when analyzing Likert-scale data parametric tests are adequately robust and will generate impartial answers that approximate reality. Therefore, the Pearson correlation coefficient was used to measure the relationships between the predictor and outcome variables.

The strength or magnitude of the relationship between the variables was determined by effect size metrics (Polit & Beck, 2012). For ordinal data, Ferguson (2009) states that Pearson's correlation coefficient is better than other effect size metrics, such as Cohen's *d*. The association index that is used for interpreting the strength of the effect sizes for social science research is as follows: a small effect size = .2; a moderate effect size = .5; and a strong effect size = .8. Statistical significance for the Pearson correlations was determined by an alpha level of .05 or less (Nunnally, 1978).

Survey Scoring

This survey consisted of items that participants responded to on a 7-point Likert-type, or closed format, scale (Dillman et al., 2014). Closed format Likert items do not include an option for participants to "write in" a response if none of the selections are appropriate. Furthermore, Likert-type items or questions utilize an ordinal scale of measurement to collect participants' responses. Each Likert category was assigned a quantitative and qualitative label with positive or more favorable responses being on the higher end of the Likert scale – 1 = Strongly Disagree; 2 = Somewhat Disagree; 3 = Slightly Disagree; 4 = Neither Agree nor Disagree; 5 = Slightly Agree; 6 = Somewhat Agree; 7 = Strongly Agree. The numeric values along the Likert scale allowed for participants' responses to be summated which is helpful for statistical analysis (Polit & Beck, 2012).

Data Collection and Procedure

Web-based Survey

This study utilized a web-based survey which is a completely electronic method for collecting participants' responses (Dillman et al., 2014). Web-based surveys are the "fastest growing form of surveying occurring in the United States, as well as throughout most of the world" (Dillman et al., 2014, p. 301). This type of surveying is attractive because of its speed, low cost, and economies of scale. One of the biggest challenges to web-based surveying is mobile devices which cause some formatting issues when the survey is viewed on a mobile device versus a laptop or home computer, and sometimes can cause participants to delay following up on email requests that need more attention until they are at a laptop or home computer. Although these survey design challenges have been addressed using the Qualtrics web-based application, another important concern that researchers face with survey implementation is a low response rate, especially for web-based surveys. Dillman et al. (2014) suggest researchers employ social exchange principles to increase response rates by helping respondents believe and trust that the benefits for complying with that request will eventually exceed the costs of complying. These benefits may be a sense of reward knowing they have helped someone, or the reward of showing positive regard towards others, or receiving verbal appreciation, or having the favor of participation returned later. Several ways surveys can take advantage of these characteristics, and, thus, increase the benefits some participants may feel for responding to survey requests are as follows: (1) specify how the survey results will be useful; (2) ask for help or advice; (3) ask interesting questions; (4) utilize sponsorship by a legitimate organization; (5) stress that opportunities to participate are limited; and (6) convey that others have responded. Therefore, this study has incorporated these principles in the data collection process.

The original and follow up emails, general announcements, and social media announcements were sent from the researcher's university email or social media accounts. This was to reduce the number of undeliverable emails or announcements as well as prevent any routing or spam mail issues.

Ethical Considerations

Institutional Review Board (IRB) approval was obtained from Virginia Commonwealth University prior to recruiting subjects and collecting data using the web-based survey (Appendix 8). This study was submitted to the IRB under exempt status, since the survey did not collect identifying information, did not involve children, and did not place subjects at risk.

Data Analysis

Coding and Storage

Survey results were downloaded from Qualtrics into IBM SPSS for statistical analyses. Missing data were addressed using procedures outlined in Tabachnik & Fidell (2013). Data cleaning was conducted to identify and remove any outliers. All data is stored in the researcher's Virginia Commonwealth University virtual file locker which is password protected using two-factor authentication. Stored data did not contain any identifying information.

Descriptive Statistics

Descriptive univariate statistics were used to summarize demographic data. Means and standard deviations were used to summarize participants' age. Frequencies and percentages were used to summarize the remaining demographic data. Item response frequencies for each potential user group were tabulated to describe group differences. Of particular interest is each potential user group's overall behavioral intention to use telerehabilitation technology as a low vision service delivery option.

Bivariate Statistics

Several studies that have investigated the topic of technology acceptance and use have identified age, gender and experience as moderator variables (i.e., Venkatesh et al., 2003; Walker, 2014; Phichitchaisopai & Naenna, 2013). However, due to an expected small sample size, this study had a limited ability to explore the moderating relationship between these characteristics and the study outcomes. Rather, this study considered these characteristics as confounders. Pearson correlations were used to determine if the performance expectancy, effort expectancy, resistance to change, and technology anxiety constructs were associated with age, gender, and experience. If these constructs were related with age, gender, and experience then they were considered as confounding variables in the study's model.

Pearson correlation coefficients were used to describe the strength of the relationship between the predictor variables and the outcome variable. Partial correlations were conducted to determine if the relationship between the predictor and outcome variables existed after controlling for the variables identified in previous literature (e.g., Venkatesh et al., 2003; Walker, 2014; Phichitchaisopai & Naenna, 2013) as moderator variables (i.e., age, gender, and experience).

Hypotheses

This study's hypotheses are as follows:

H1: The UTAUT model explains a relationship between the predictors and behavioral intention.

Pearson correlations were calculated to determine the strength of the relationship between the following variables: (a) performance expectancy and behavioral intention;

(b) effort expectancy and behavioral intention; (c) resistance to change and behavioral intention; and (d) technology anxiety and behavioral intention. The strength of the relationships between the predictor and outcome variables will be interpreted using the following effect size metrics: (1) a small effect size = a Pearson correlation coefficient of .2; (2) a moderate effect size = a Pearson correlation coefficient of .5;and (3) a strong effect size = a Pearson correlation coefficient of .8 (Ferguson, 2009).

H2: Performance expectancy has a positive relationship with behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option adjusted for age and gender.

According to Venkatesh et al. (2003), performance expectancy was the strongest predictor of behavioral intention. They also noted that the strength of the relationship between performance expectancy and behavioral intention was moderated by age and gender. A correlation was used to determine if a relationship existed between performance expectancy and behavioral intention to use telerehabilitation technology as well as the strength of the relationship between these two variables. Partial correlations were used to assess the strength of the relationship between performance expectancy and behavioral intention when adjusting for age and gender. The strength of the relationships between the variables was interpreted using the following effect size metrics: (1) a small effect size = a Pearson correlation coefficient of .2; (2) a moderate effect size = a Pearson correlation coefficient of .5; and (3) a strong effect size = a Pearson correlation of coefficient of .8 (Ferguson, 2009).

H3: Effort expectancy has a positive relationship with behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option adjusted for age, gender, and experience.

Venkatesh et al. (2003) also found that effort expectancy was a significant predictor of behavioral intention to accept and use technology. They found that the strength of the relationship between effort expectancy and behavioral intention was moderated by age, gender, and experience. In this study, a correlation was used to establish if a relationship exists, and the strength of that relationship, between effort expectancy and behavioral intention to use telerehabilitation technology. Partial correlations were conducted to determine the strength of the relationship between effort expectancy and behavioral intention when adjusting for age, gender, and experience. The strength of the relationships between the variables was interpreted using the following effect size metrics: (1) a small effect size = a Pearson correlation coefficient of .2; (2) a moderate effect size = a Pearson correlation coefficient of .5;and (3) a strong effect size = a Pearson correlation of coefficient of .8 (Ferguson, 2009).

H4: Technology anxiety has a negative relationship with behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option that is adjusted for age, gender, and experience.

Although Venkatesh et al. (2003) found technology anxiety to be an indirect determinant of behavioral intention, Hoque and Sorwar (2017) found technology anxiety to be a significant negative predictor of behavioral intention. In this study, a correlation was performed to determine if an inverse relationship exists between technology anxiety and behavioral intention to use telerehabilitation technology, and to determine the strength of the relationship if it exists. Partial correlations were conducted to find if a relationship exists between technology anxiety and behavioral intention while adjusting for age, gender, and experience. The strength of the relationships between the variables was interpreted using the following effect size metrics: (1) a small effect size = a Pearson correlation coefficient of .2; (2) a moderate effect size = a Pearson correlation coefficient of .5;and (3) a strong effect size = a Pearson correlation of coefficient of .8 (Ferguson, 2009).

H5: Resistance to change has a negative relationship with behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option that is adjusted for age, gender, and experience.

Hoque and Sorwar (2017) noted that resistance to change had a negative effect on behavioral intention which influenced people's likelihood to accept and use new technology. In this study, a correlation was used to assess if an inverse relationship exists between resistance to change and behavioral intention to use telerehabilitation technology, and to determine the strength of the relationship if it exists. Partial correlations were also performed to find if the relationship between resistance to change and behavioral intention exists after adjusting for age, gender, and experience. The strength of the relationships between the variables was interpreted using the following effect size metrics: (1) a small effect size = a Pearson correlation coefficient of .2; (2) a moderate effect size = a Pearson correlation coefficient of .5;and (3) a strong effect size = a Pearson correlation of coefficient of .8 (Ferguson, 2009).

Summary

This cross-sectional descriptive survey explored the topics of telerehabilitation as a low vision rehabilitation service delivery model and factors that predict behavioral intention to accept and use telerehabilitation technology. These topics were used to provide an understanding of potential users' behavioral intentions to accept and use telerehabilitation to complement the current face-to-face low vision rehabilitation service delivery option. Potential users were recruited via email, general announcement, and social media announcement to address the hypotheses related to the various constructs' effects on behavioral intention. As discussed in the following chapter, results from this study can provide feasibility information on whether all potential users, or stakeholders, (i.e., eye care professionals, low vision rehabilitation professionals, and people who have a moderate to near total vision impairment) would accept and use telerehabilitation as a means of delivering low vision rehabilitation services if telerehabilitation was implemented as an option. This pilot study can serve as a foundation for future more comprehensive surveys of this construct.

The following chapter contains the data, findings, and statistical analyses obtained from this study. Chapter Five provides a discussion of the statistical findings, conclusions, limitations, and implications taken from this study.

Chapter 4

Results

Data Collection Review

The purpose of this study was to investigate the behavioral intention of key stakeholders to use telerehabilitation as a low vision rehabilitation service delivery option. Data were collected utilizing a pre-validated web-based survey administered via Qualtrics (Qualtrics, 2021a; Qualtrics, 2021b; Qualtrics, 2021c). The study population included the three stakeholder groups who live, at least, part-time in the United States: people with vision impairments, eye care professionals, and vision rehabilitation professionals. Participants from these stakeholder groups were recruited through email, social media, and general announcement.

Methodology Review

An introductory message was sent to potential participants which include people with vision impairments, ophthalmologists, optometrists, low vision therapists, rehabilitation counselors, orientation and mobility specialists, occupational therapists, and vision rehabilitation therapists. This initial message was sent through several methods: (a) the researcher's Virginia Commonwealth University email; (b) eye care professional listservs, vision rehabilitation professional listservs, and people with vision impairment listservs; (c) podcasts and YouTube channels that target one of the three stakeholder groups; and (d) the researcher's Virginia Commonwealth University social media accounts (i.e., Facebook, LinkedIn, Instagram, and Twitter). Participant recruitment also occurred asking recipients to "please feel free to share the survey link with anyone that meets the study's criteria and would be willing to participate." A follow up message containing study instructions and the survey link was sent out via one or more of the above mentioned methods to recruit additional participants.

The original study design allowed for 1 month to collect data; however, the data collection period was extended by 2 months to maximize recruitment of potential participants. A total of 113 participants responded to the survey with 47 participants (41.6%) completing the entire survey.

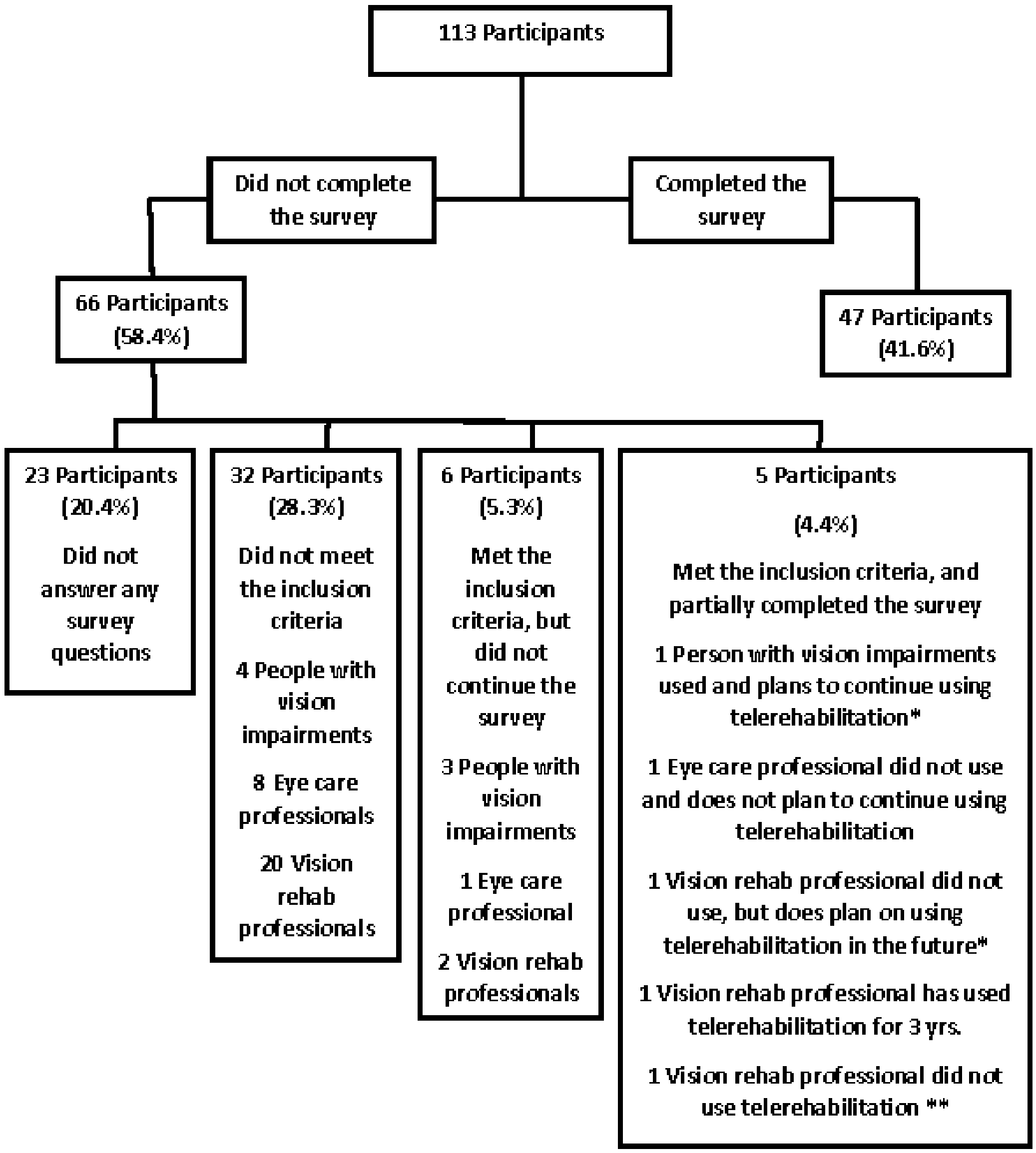
Data Preparation and Cleaning

Data were imported from Qualtrics (Qualtrics, 2021a) into the Statistical Package for Social Sciences (IBM SPSS v. 22) where it was cleaned to remove participant cases that did not answer any survey questions, did not meet the inclusion criteria, or met the inclusion criteria but did not answer any other survey questions. Five participants met the inclusion criteria and partially completed the survey, which were retained for the following analyses due to the study's small sample size: (a) n = 5 for descriptive statistics; (b) n = 3 for correlational analysis of performance expectancy and behavioral intention; and (c) n = 1 for correlational analysis of effort expectancy and behavioral intention. Figure 9 provides a flowchart of the sample's participation in the survey.

Participant Demographics

A total of fifty-two people participated in the survey – 12 males (23%) and 40 females (77%). The sample's age ranged from 21 to 79 years of age (M = 45.2, SD = 12.6). Twenty-two people with vision impairments (42%) participated in the survey, followed by 21 (40%) vision rehabilitation professionals, and nine (17%) eye care professionals. Table 5 provides the descriptive statistics by stakeholder group.

Figure 9: Flowchart of Study's Sample



Note: * Completed the performance expectancy items
** Completed the performance and effort expectancy items

Table 5: Descriptive Statistics by Stakeholder Group

Group	Variable		Summary
People with Vision Impairments (n = 22, 42%)	Age		45.6 (15.9)
	Gender:	Male	9 (17%)
		Female	13 (25%)
	TR Use	0 – 1 yrs	2 (4%)
		2 – 3 yrs	0 (0%)
		4 – 5 yrs	0 (0%)
		6 – 7 yrs	0 (0%)
		8 – 9 yrs	0 (0%)
		10+ yrs	1 (2%)
Eye Care Professionals (n = 9, 17%)	Age		45.2 (10%)
	Gender:	Male	3 (6%)
		Female	6 (12%)
	TR Use	0 – 1 yrs	2 (4%)
		2 – 3 yrs	0 (0%)
		4 - 5 yrs	1 (2%)
		6 – 7 yrs	0 (0%)
		8 – 9 yrs	0 (0%)
		10+ yrs	0 (0%)
Vision Rehabilitation Professionals (n = 21, 40%)	Age		44.7 (9.8)
	Gender:	Male	0 (0%)
		Female	21 (40%)

Group	Variable		Summary
	TR Use	**0 – 1 yrs**	**13 (25%)**
		2 – 3 yrs	**0 (0%)**
		4 – 5 yrs	**1 (2%)**
		6 – 7 yrs	**0 (0%)**
		8 – 9 yrs	**0 (0%)**
		10+ yrs	**1 (2%)**

Note: Summary statistics are mean and standard deviation, or frequency and percentage. TR Use = Participants who reported using telerehabilitation.

In the people with vision impairments group, 4 participants (18%) lived in a rural area, 9 participants (41%) lived in a suburban area, and 9 participants (41%) lived in an urban area. These participants reported having 12 different eye diseases/conditions that are summarized in Table 6. They also reported the amount of time they have lived with their vision condition: two participants (9%) for 0 – 5 years, two participants (9%) for 6 – 10 years, four participants (18%) for 11 – 15 years, 13 participants (59%) for 20+ years, and 1 participant (5%) did not answer the question. Four participants (18%)

Table 6: Eye Conditions of People with Vision Impairments

Condition	N	%
Retinitis pigmentosa (RP)	4	18.2
Optic nerve atrophy	3	13.6
Retinopathy of prematurity (ROP)	3	13.6
Aniridia	2	9.1

Condition	N	%
Glaucoma and cataracts	2	9.1
Stargardt's Disease	2	9.1
Albinism	1	4.5
Detached retina	1	4.5
Leber's Hereditary Optic Neuropathy	1	4.5
Pseudo Tumor Cerebri	1	4.5
Retinal disease	1	4.5
Stroke	1	4.5

reported that their best corrected visual acuity is less than 20/60, 7 participants' (32%) best corrected visual acuity is less than 20/160 or visual field is 20 degrees or less, 5 participants' (23%) best corrected visual acuity is less than 20/400 or visual field is 10 degrees or less, 4 participants' (18%) best corrected visual acuity is less than 20/1000 or visual field is 5 degrees or less, and 2 participants (9%) reported having no light perception. Thirteen participants (59%) reported that their vision condition is somewhat stable, 8 participants (36%) reported that their vision condition is very stable, and 1 participant (5%) did not report how stable their vision condition is. In general, eighteen participants (82%) reported having received low vision rehabilitation services for their vision condition, 3 participants (14%) reported not receiving low vision rehabilitation services for their vision condition, and 1 participant (5%) did not answer the question. Information regarding the specific low vision rehabilitation services these participants received is detailed in Table 7.

Table 7: Low Vision Rehabilitation Services Received

Item	Low Vision Rehabilitation Services			
	Low Vision Therapy	Occupational Therapy	Orientation and Mobility	Vision Rehabilitation
Which services have you received for your vision impairment?	8	5	16	8
How many times have you received services for your vision impairment?[a]	M = 3.7 SD = 2.4	M = 6.0 SD = 6.1	M = 4.1 SD = 5.2	M = 3.7 SD = 3.2
How difficult was it to schedule your sessions?				
Not difficult at all	4	1	11	4
A little difficult	2	-	2	2
Somewhat difficult	1	3	2	2
Very difficult	1	1	1	-
How difficult was it to make it to your sessions?				
Not difficult at all	4	3	9	5
A little difficult	4	1	5	1
Somewhat difficult	-	1	2	2
Very difficult	-	-	-	-

Note: Values are the frequencies of each item unless otherwise indicated.

[a] Sample sizes are 7, 4, 15, and 6 in the Low Vision Therapy, Occupational Therapy, Orientation and Mobility, and Vision Rehabilitation groups, respectively

Eye care professionals consisted of 3 ophthalmologists (33%) and 6 optometrists (67%). These participants stated that they see between 3 and 50 patients (M = 15.8, SD = 14.4) during a typical week that have a visual acuity of 20/60 or less, or a central visual field of 20 degrees or less. Eight participants (89%) reported working in an urban area while 1 participant (11%) reported working in a suburban area.

The vision rehabilitation professional group was composed of 1 low vision therapist (5%), 7 occupational therapists (33%), 9 orientation and mobility specialists (43%), 3 vision rehabilitation therapists (14%), and 1 vocational rehabilitation counselor (5%). These professionals reported a wide range of experience working with people who have vision impairments: 4 participants (19%) had 0 – 5 years of experience, 4 participants (19%) had 6 – 10 years of experience, 5 participants (24%) had 11 – 15 years of experience, 3 participants (14%) had 16 – 20 years of experience, and 5 participants (24%) had over 20 years of experience. They stated working with 1 to 22 clients (M = 11.7, SD = 5.8) with vision impairments during a typical week. Fifteen participants (71%) noted that they travel between 15 to 100 miles (M = 43.1, SD = 25.2) on average to clients' homes to provide services. Most of the vision rehabilitation professionals stated that they work in a suburban area (N = 14, 67%), followed by 4 participants (19%) that work in a rural area, and 3 participants (14%) that work in an urban area. Lastly, 3 participants (14%) reported having one of the following vision impairments: myopia, mucosal epithelial dysplasia, and retinitis pigmentosa. All three participants have had their vision impairment for more than 20 years with one participant (33%) having a best corrected visual acuity of less than 20/60 and two participants (67%) having a best corrected visual acuity of less than 20/160 or a visual field of 20 degrees or less.

Three participants emailed this researcher to request the results of the survey. This chapter containing the data and statistical analyses will be sent to these participants via email.

Comfort with Technology

A majority of the study's participants reported feeling very comfortable with using the following technologies: computers (85%), mobile devices (e.g., mobile phones and tablets) (85%), and videoconferencing programs (e.g., Facetime, Skype, and Facebook Messenger) (64%). Most of the participants reported being very skilled in the use of the following technologies: computers (70%), mobile devices (76%), and videoconferencing programs (59%). All of the participants reported having an email account and used the following devices to send and receive emails: computer ($n = 45$), mobile phone ($n = 43$), and tablet ($n = 24$). One participant reported never or almost never going on the internet while the other participants reported searching the internet with computers ($n = 42$), mobile phones ($n = 41$), and tablets ($n = 30$). Similarly, one participant reported not using a computer or mobile device to write letters or other documents while the other participants reported using the following technology to write letters or other documents: computers ($n = 43$), mobile phones ($n = 21$), and tablets ($n = 17$). When asked how many years have they used a computer in your home or at work, 1 participant (2%) reported 0 years; 2 participants (4%) reported 1 – 5 years; 1 participant (2%) reported 6 – 10 years; 3 participants (7%) reported 11 – 15 years, 8 participants (17%) reported 16 – 20 years, and 31 participants (67%) reported 21 or more years. When asked how many years have they used a mobile device (i.e., mobile phone or tablet) in your home or at work, 1 participant (2%) reported 1 – 5 years; 8 participants (18%) reported 6 – 10 years; 18 participants (40%) reported 11 – 15 years, 10 participants (22%) reported 16 – 20 years, and 8 participants (18%) reported 21 or more years. Table 8 breaks participants level of comfort with technology down by stakeholder group (i.e., person with vision impairment, eye care professional, and vision rehabilitation professional).

Table 8: Level of Comfort with Technology by Stakeholder Group

	Stakeholder Group		
Item	Person with Vision Impairment N(%)	Eye Care Professional N(%)	Vision Rehab Professional N(%)
How comfortable are you with using computers?			
Not at all comfortable	2 (10%)	-	-
A little comfortable	-	-	1 (6%)
Somewhat comfortable	2 (10%)	-	2 (11%)
Very comfortable	17 (81%)	8 (100%)	15 (83%)
How comfortable are you with using mobile devices, like mobile phones and tablets?			
Not at all comfortable	1 (5%)	-	1 (6%)
A little comfortable	1 (5%)	-	-
Somewhat comfortable	4 (19%)	-	-
Very comfortable	15 (71%)	8 (100%)	17 (94%)
How comfortable are you with using videoconferencing programs, like Facetime, Skype, and Facebook Messenger?			
Not at all comfortable	4 (19%)	-	-
A little comfortable	3 (14%)	-	2 (11%)
Somewhat comfortable	4 (19%)	-	4 (22%)
Very comfortable	10 (48%)	8 (100%)	12 (67%)
How skilled are you with using computers?			
Not at all skilled	-	-	-
A little skilled	2 (10%)	-	1 (6%)
Somewhat skilled	9 (43%)	-	2 (12%)
Very skilled	10 (48%)	8 (100%)	14 (82%)
How skilled are you with using mobile devices?			
Not at all skilled	-	-	-
A little skilled	2 (10%)	-	-
Somewhat skilled	7 (33%)	-	2 (12%)
Very skilled	12 (57%)	8 (100%)	15 (88%)
How skilled are you with using videoconferencing programs, like Facetime, Skype, and Facebook Messenger?			
Not at all skilled	3 (14%)	-	-
A little skilled	2 (10%)	-	2 (12%)
Somewhat skilled	7 (33%)	2 (25%)	3 (18%)

Item	Person with Vision Impairment N(%)	Eye Care Professional N(%)	Vision Rehab Professional N(%)
	Stakeholder Group		
Very skilled	9 (43%)	6 (75%)	12 (71%)
Which of the following do you use to send and receive emails?[a]			
Computer / laptop	20 (95%)	8 (100%)	17 (94%)
Mobile phone	18 (86%)	8 (100%)	17 (94%)
Tablet	11 (52%)	2 (25%)	11 (61%)
I do not have an email account	-	-	-
Which of the following do you use to search the internet?[a]			
Computer / laptop	17 (81%)	8 (100%)	17 (94%)
Mobile phone	16 (76%)	8 (100%)	17 (94%)
Tablet	11 (52%)	4 (50%)	13 (72%)
I never or almost never get on the internet	1 (5%)	-	-
Which of the following do you use to write letters or documents?[a]			
Computer / laptop	18 (86%)	8 (100%)	17 (94%)
Mobile phone	7 (33%)	2 (25%)	12 (67%)
Tablet	8 (38%)	1 (12.5%)	8 (44%)
I do not write letters or other documents on a computer or mobile device	1 (5%)	-	-
How many years have you been using a computer in your home or at work?			
0 years	1 (5%)	-	-
1 – 5 years	2 (10%)	-	-
6 – 10 years	1 (5%)	-	-
11 – 15 years	1 (5%)	-	2 (12%)
16 – 20 years	5 (24%)	1 (13%)	2 (12%)
21 or more years	11 (52%)	7 (88%)	13 (77%)
How many years have you been using a mobile device (i.e., mobile phone or tablet) in your home or at work?			
0 years	-	-	-
1 – 5 years	1 (5%)	-	-
6 – 10 years	5 (25%)	1 (13%)	2 (12%)
11 – 15 years	10 (50%)	3 (38%)	5 (29%)
16 – 20 years	2 (10%)	3 (38%)	5 (29%)
21 or more years	2 (10%)	1 (13%)	5 (29%)

Note: [a] Options are not mutually exclusive and rows do not sum to 100%

Behavioral Intention to Use Telerehabilitation

When participants were asked if they planned to use telerehabilitation in the future, 8 participants (17%) responded that they slightly disagreed to strongly disagreed that they had plans to use telerehabilitation in the future, 19 participants (40%) were not sure or did not know if they would use telerehabilitation, and 20 participants (43%)

responded slightly agreeing to strongly agreeing that they planned on using telerehabilitation in the future. In response to being asked if they planned to use telerehabilitation in their daily life, 16 participants (34%) stated that they slightly to strongly disagreed that they planned on using telerehabilitation in their daily lives, 14 participants (30%) reported that they were not sure or did not know, and 17 participants (36%) stated slightly agreeing to strongly agreeing that they planned on using telerehabilitation in their daily lives. Lastly, participants were asked if they planned to use telerehabilitation frequently: 19 participants (40%) reported slightly disagreeing to strongly disagreeing that they would use telerehabilitation frequently, 14 participants (30%) stated that they were not sure or did not know, and 14 participants (30%) reported slightly agreeing to strongly agreeing that they would use telerehabilitation frequently. Table 9 describes the behavioral intention to use telerehabilitation for each stakeholder group.

Table 9: Behavioral Intention to Use Telerehabilitation by Stakeholder Group

	Stakeholder Group		
Item	Person with Vision Impairment N(%)	Eye Care Professional N(%)	Vision Rehab Professional N(%)
I plan to use telerehabilitation in the future?			
Strongly disagree	1 (5%)	-	-
Somewhat disagree	1 (5%)	-	5 (28%)
Slightly disagree	-	-	1 (6%)
Neither agree nor disagree	5 (24%)	1 (13%)	3 (17%)
Slightly agree	3 (14%)	1 (13%)	2 (11%)
Somewhat agree	-	-	1 (6%)
Strongly agree	4 (19%)	4 (50%)	5 (28%)
Do not know	7 (33%)	2 (25%)	1 (6%)
Summary Statistics for Item[a]	5.(2.2)	6 (1.4)	4 (2.2)
I will try to use telerehabilitation in my daily life?			
Strongly disagree	3 (14%)	-	2 (11%)
Somewhat disagree	1 (5%)	1 (13%)	5 (28%)
Slightly disagree	2 (10%)	2 (25%)	-
Neither agree nor disagree	3 (14%)	1 (13%)	2 (11%)
Slightly agree	2 (10%)	1 (13%)	2 (11%)
Somewhat agree	1 (5%)	2 (25%)	3 (17%)

Item	Stakeholder Group: Person with Vision Impairment N(%)	Eye Care Professional N(%)	Vision Rehab Professional N(%)
Strongly agree	2 (10%)	1 (13%)	3 (17%)
Do not know	7 (33%)	-	1 (6%)
Summary Statistics for Item[a]	5.(2.7)	4 (1.8)	4 (2.3)
I plan to use telerehabilitation frequently?			
Strongly disagree	4 (19%)	-	4 (22%)
Somewhat disagree	2 (10%)	2 (25%)	5 (28%)
Slightly disagree	1 (5%)	-	1 (6%)
Neither agree nor disagree	3 (14%)	2 (25%)	1 (6%)
Slightly agree	3 (14%)	-	1 (6%)
Somewhat agree	-	2 (25%)	2 (11%)
Strongly agree	1 (5%)	2 (25%)	3 (17%)
Do not know	7 (33%)	-	1 (6%)
Summary Statistics for Item[a]	4 (2.8)	4 (2.1)	3 (2.5)

Note: [a]Summary statistics consist of means and standard deviations

Validity and Reliability

The study's face and content validity were previously established by aligning the survey's items with the study's constructs, and by pretesting the survey with a group of five experts. The construct validity of the survey was based on the item loadings and average variance extracted (AVE) values. Items representing each construct loaded highest on one of four components, except for the last resistance to change item that had a loading of .137 and asked "most often I have a 'tried and true' way that I like to do things rather than trying a new and different way." This item was removed from any further analysis due to its ambiguity and relevance to the resistance to change construct. Several items were noted to cross load into other components which was to be expected due to the small sample size of this study; however, items that cross loaded into other components had, at least, a .2 difference between the main factor and any other factor it loaded onto, except for technology anxiety item #5 which was off by .02 and too close to the required value that it was not deleted from this analysis (Hair et al., 2009). A principle component analysis was performed to determine the average loadings and average variance extracted (AVE) of the items in each of the survey's four constructs. The survey's convergent validity was satisfactory due to the AVE for each construct being greater than .5 – construct AVE scores ranged from .56 to .79. The survey's discriminant validity sufficiently met the criteria that the square root of each construct's AVE (i.e., scores ranged from .74 to .89) exceeded the correlations among the constructs (i.e., correlations ranged from .13 to .50).

The internal consistency reliability of all of the constructs in the survey taken together was good (Cronbach's alpha = .85). The internal consistency reliability of each construct was excellent, except for the resistance to change construct which was acceptable: performance expectancy construct Cronbach's alpha = .92; effort expectancy construct Cronbach's alpha = .94; technology anxiety construct Cronbach's alpha = .91; and the resistance to change construct Cronbach's alpha = .77. The construct reliability for each construct was excellent, except for the resistance to change construct which was good: performance expectancy construct was .92; effort expectancy construct was .95; technology anxiety construct was .93; resistance to change construct was .84.

Hypothesis Testing

Hypothesis 1

Hypothesis 1 addressed the study's sample as a whole which consisted of combining the data from all three stakeholder groups together. The purpose of this hypothesis was to investigate the relationships between the predictor and outcome variables of the full proposed UTAUT model with its extensions and adaptations for the entire sample. The items for each construct were added together to give a composite construct score (see Table 10). A Pearson correlation was performed between the composite behavioral intention construct and the four composite predictor constructs (performance expectancy, effort expectancy, technology anxiety, and resistance to change). A significant correlation with a small effect size was found between performance expectancy and behavioral intention (r = 0.295). Another relationship with a small effect size was noted between behavioral intention and resistance to change (*r* = .254). The other relationships exhibited a small effect size.

Table 10: Composite Construct Statistics

	Summary Statistics			
Composite Construct	Total Sample	People with Vision Impairments	Eye Care Professionals	Vision Rehabilitation Professionals
Performance Expectancy	25.5 (8.3)	25.7 (7.5)	31.5 (3.6)	22.9 (9.3)
Effort Expectancy	23.5 (8.1)	23.7 (7.5)	27.4 (8.5)	21.7 (8.3)
Technology Anxiety	11.6 (8.2)	11.2 (8.2)	11.4 (9.5)	12.3 (8.0)
Resistance to Change	17.2 (5.4)	18.6 (6.0)	13.7 (5.1)	17.1 (4.1)
Behavioral Intention	14.9 (6.3)	15.8 (8.5)	15.8 (4.0)	13.6 (6.8)

Note: Summary statistics are mean and standard deviation.

Part correlations were conducted to see if the relationships between behavioral intention and the predictor variables were confounded by age, gender, and experience. The relationship between behavioral intention and three predictor variables – performance expectancy, effort expectancy, and resistance to change – had a small effect size when adjusted for age. When adjusted for gender the relationship between behavioral intention and performance expectancy as well as resistance to change was found to have a small effect size. Similarly, the relationship between behavioral intention and two predictor variables – performance expectancy and resistance to change – also had a small effect size when adjusted for experience. Table 11 contains the correlations and partial correlations between behavioral intention and these predictor variables. Although these values should be taken with caution due to the study's small sample size, these values do not support the following relationships projected by the model depicted by Figure 7 in Chapter 2: (1) a relationship between performance expectancy and behavioral intention that is moderated by age and gender; (2) a relationship between effort expectancy and behavioral intention that is moderated by age, gender, and experience; (3) a relationship between technology anxiety and behavioral intention that is moderated by age, gender, and experience; and (4) a relationship between resistance to change and behavioral intention that is moderated by age, gender, and experience.

Table 11: Correlations and Partial Correlations of Behavioral Intention and Predictor Variables

		Partial Correlations		
		Age	Gender	Experience
Predictor Variable	*r*	*r*	*r*	*r*
Performance Expectancy	.295*	.329	.296	.298
Effort Expectancy	.150	.200	.150	.116
Technology Anxiety	.050	.082	.050	.008
Resistance to Change	.254	.251	.258	.257

Note: *Significant at $p \leq .05$

Hypothesis 2

Hypothesis 2 addressed the study's sample as three separate stakeholder groups. The purpose of the hypothesis was to examine the relationship between performance expectancy and behavioral intention for each stakeholder group. A small effect size was found between behavioral intention and performance expectancy for people with vision impairments (*r* = .218) and eye care professionals (r = .414). When adjusted for age, a small effect size was noted for the people with vision impairments group that had a minimal correlation coefficient increase (*r* = .316), and the eye care professional group that had a slight correlation coefficient decrease (*r* = .293). The only change that occurred between behavioral intention and performance expectancy after adjusting for gender was for the eye care professional group which went from a small effect size to a strong effect size (*r* = .830). When adjusted for experience, the eye care professional group went from a small effect size to a moderate effect size (*r* = .671), and the vision rehabilitation professional group went from having no effect size to having a small effect size (r = .269). The increases in effect size for the eye care professional group after adjusting for gender and experience indicate that these variables have a relationship with performance expectancy. Table 12 provides the correlations and partial correlations between behavioral intention and performance expectancy for each stakeholder group.

Table 12: Correlations and Partial Correlations of Behavioral Intention and Performance Expectancy by Stakeholder Group

		Partial Correlations		
Performance Expectancy By Stakeholder Group	*r*	Age *r*	Gender *r*	Experience *r*
People with Vision Impairments	.218	.316	.215	.283
Eye Care Professionals	.414	.293	.830	.671
Vision Rehabilitation Professionals	.112	.142	.000	.269

Note: *Significant at $p \leq .05$

Hypothesis 3

Hypothesis 3 addressed the study's sample as three separate stakeholder groups. The purpose of this hypothesis was to investigate the relationship between effort expectancy and behavioral intention for each stakeholder group. A negative correlation with no effect size was observed between effort expectancy and behavioral intention for the eye care professional group (*r* = -.104) and the vision rehabilitation professional group (*r* = -.127) while a small effect size was found for the people with vision impairments group (*r* = .271). When adjusted for age, there was a slight positive increase for each stakeholder group, but no changes in significance or effect size were noted. No changes in significance level or effect size were noted for each stakeholder group when adjusted for gender. When adjusted for experience, slight positive increases in correlation coefficients were observed for the people with vision impairment group (*r* = .346) and vision rehabilitation professional group (*r* = .113). A negative increase in correlation coefficients from no effect size to small effect size was found for the eye care professional group. Table 13 provides the correlations and partial correlations between behavioral intention and effort expectancy for each stakeholder group.

Table 13: Correlations and Partial Correlations of Behavioral Intention and Effort Expectancy by Stakeholder Group

		Partial Correlations		
Effort Expectancy By Stakeholder Group	*r*	Age *r*	Gender *r*	Experience *r*
People with Vision Impairments	.271	.354	.267	.346
Eye Care Professionals	-.104	.008	-.105	-.302
Vision Rehabilitation Professionals	-.127	-.104	.000	.113

Note: *Significant at p ≤ .05

Hypothesis 4

Hypothesis 4 addressed the study's sample as three separate stakeholder groups. The purpose of the hypothesis was to examine the relationship between technology anxiety and behavioral intention for each stakeholder group. A small effect size was observed between behavioral intention and technology anxiety for the eye care professional group (*r* = .213), and a negative small effect size was noted for the people with vision impairments group (*r* = -.321). When adjusted for age, no changes in effect size or significance were found for the people with vision impairments group (*r* = -.285) and the vision rehabilitation professional group (*r* = .015) while a decrease in the correlation coefficient value went from a small effect size to no effects size for the eye care professional group (r = .089). No changes were observed for significance or effect size in the correlation coefficients for any of the groups when adjusted for gender. Similarly, no changes in significance or effect size were noted for any of the correlation coefficients for any of the groups when adjusted for experience, except for the eye care professional group that had a correlation coefficient increase from a small effect size to a moderate effect size (*r* = .515). Table 14 provides the correlations and partial correlations between behavioral intention and technology anxiety for each stakeholder group.

Table 14: Correlations and Partial Correlations of Behavioral Intention and Technology Anxiety by Stakeholder Group

		Partial Correlations		
Technology Anxiety By Stakeholder Group	*r*	Age *r*	Gender *r*	Experience *r*
People with Vision Impairments	-.321	-.285	-.323	-.287
Eye Care Professionals	.213	.089	.222	.515
Vision Rehabilitation Professionals	.161	.015	.000	.143

Note: *Significant at p $\leq$ .05

Hypothesis 5

Hypothesis 5 addressed the study's sample as three separate stakeholder groups. The purpose of this hypothesis was to investigate the relationship between resistance to change and behavioral intention for each stakeholder group. A small effect size was obtained between behavioral intention and resistance to change for the vision rehabilitation professional group (*r* = .243). A positive correlation coefficient with no effect size was found for the people with vision impairments group (*r* = .167) while a no effect size negative correlation coefficient was noted for the eye care professional group (*r* = -.045). When adjusted for age, the correlation coefficient for the vision rehabilitation group decreased from a small effect size to no effect size (*r* = .182), and the correlation coefficient for the eye care professional group went from a negative value to a positive value (*r* = .048). When adjusted for gender, the eye care professional group correlation coefficient went from a negative no effect size value to a negative moderate effect size value (*r* = -.562), and the vision rehabilitation professionals' correlation coefficient went from a small effect size to a no effect size value (*r* = .000). When adjusted for experience, only a small decrease in correlation coefficient value was noted for the people with vision impairments group, and the eye care professional group went from a negative no effect size correlation coefficient to a negative small effect size correlation coefficient (*r* = -.220). The vision rehabilitation group went from a small effect size correlation coefficient to a moderate effect size correlation coefficient (*r* = .463). Table 15 provides the correlations and partial correlations between behavioral intention and resistance to change for each stakeholder group.

Table 15: Correlations and Partial Correlations of Behavioral Intention and Resistance to Change by Stakeholder Group

		Partial Correlations		
Resistance to Change By Stakeholder Group	*r*	Age *r*	Gender *r*	Experience *r*
People with Vision Impairments	.167	.179	.191	.112
Eye Care Professionals	-.045	.048	-.562	-.220
Vision Rehabilitation Professionals	.243	.182	.000	.463

Note: *Significant at $p \leq .05$

Summary

This chapter addressed the statistical findings and data analysis from the behavioral intention survey. The hypotheses presented in Chapter 3 were addressed. The following chapter will provide a discussion of these findings, conclusions drawn from the study, and implications for future directions.

Chapter Five

Discussion

This study examined the behavioral intention of three stakeholder groups -- people with vision impairments, eye care professionals, and vision rehabilitation professionals -- to use telerehabilitation as a low vision rehabilitation service delivery option. The specific aims of the study were to: (1) pilot test a survey designed to collect data from people with vision impairments, eye care professionals, and vision rehabilitation professionals regarding their behavioral intention to use low vision telerehabilitation services which can be used later on a larger population; (2) provide the first evidence on the behavioral intention of people with vision impairments and the professionals who work with them to use low vision telerehabilitation services; (3) give evidence to support an adapted and expanded version of the UTAUT in relation to behavioral intention to use telerehabilitation services in the area of low vision rehabilitation; and (4) explore the relationships between behavioral intention and the variables that are thought to predict behavioral intention to use low vision telerehabilitation services.

This quantitative, non-experimental, descriptive study utilized a cross-sectional survey design using a pre-validated instrument administered over the Internet. This chapter provides a discussion of the demographic characteristics of the sample, summarizes the statistical findings related to the study's hypotheses, and addresses the study's limitations, relevance to the areas of telerehabilitation and low vision rehabilitation, implications for practice, and recommendations for future research. To date, no other studies have explored the behavioral intention of any group with relation to the use of telerehabilitation as a low vision rehabilitation service delivery option.

Demographic Characteristics

A total of *N* = 52 people participated in this survey. Demographic characteristics revealed that the sample disproportionately consisted of more females (77%) than males (23%) as well as more people with vision impairments (42%) and vision rehabilitation professionals (40.4%) than eye care professionals (17%). The mean age of each group was approximately the same: people with vision impairments (*M* = 45.6), eye care professionals (*M* = 45.2), and vision rehabilitation professionals (*M* = 44.7). Most people from each group that reported using telerehabilitation stated that they had less than one year of experience using it.

People with Vision Impairments Group

Twenty-two people who identified as having a vision impairment responded to the survey. A few trends were gleamed from the analysis of survey data. One trend was that most of the people with vision impairments lived in either an urban (41%) or a suburban (41%) area which may explain their use of a variety of low vision rehabilitation services with the most participants receiving orientation and mobility services (*N* = 16), followed by vision rehabilitation services (*N* = 8), and low vision therapy services (*N* = 8) and, lastly, by occupational therapy services (*N* = 5). A majority of the respondents reported that scheduling these services was not difficult at all, except for occupational therapy services, which 80% of responders reported being somewhat to very difficult to schedule. Another interesting trend was how many vision impairment responders stated that making it to the various low vision rehabilitation services was not difficult at all out of the total number of responders in each category: 4 out of 8 for low vision therapy (50%); 3 out of 5 for occupational therapy (60%); 9 out of 16 for orientation and mobility (56%); and 5 out of 8 for vision rehabilitation (63%). This is interesting because these numbers demonstrate this sample's access and utilization of low vision services at the higher end of percentage range given by Lam and Leat (2013) – 29 to 75%. Additionally, difficulty making it to low vision rehabilitation services is reported as one of the major issues and limitations to the access and utilization of services by people with vision impairments (O'Connor, Mu, & Keeffe, 2008; Overbury, & Wittich, 2011; Southall, & Wittich, 2012). A third trend is that most of the people with vision impairments felt somewhat to very comfortable using computers (91%), mobile devices (90%), and videoconferencing programs (67%). They likewise stated feeling somewhat to very skilled using computers (91%), mobile devices (90%), and videoconferencing programs (76.2%). However, only 7 participants (33%) reported slightly to strongly agreeing that they planned to use telerehabilitation in the future, and fewer participants (25%) reported slightly to strongly agreeing with planning on using it in their daily lives, and still less reported slightly to strongly agreeing with planning on using telerehabilitation. This is contrary to Hoque and Sorwar's (2017) assertion that increased comfort and experience with technology should decrease technology anxiety which, in turn, should increase behavioral intention to use technology. Despite feeling very comfortable and skilled at using various technologies, participants with vision impairments had a low composite behavioral intention to use telerehabilitation (M = 15.8, SD = 8.5) similar to the total sample (M = 14.9, SD = 6.3), eye care professional group (M = 15.8, SD = 4.0), and vision rehabilitation professionals (M = 13.6, SD = 6.8). This means that all participants, in general, had less likelihood of accepting and planning on using low vision telerehabilitation services. Similarly, participants with vision impairments also had a low composite technology anxiety to use low vision telerehabilitation services (M = 11.2, SD = 8.2) that was like the total sample (M = 11.6, SD = 8.2), eye care professional group (M = 11.4, SD = 9.5), and vision rehabilitation professionals (M = 12.3, SD = 8.0), which indicates that all participants reported more feelings of anxiety associated with using telerehabilitation. Given the study's limited sample size, it is difficult to speculate on whether participants' reported increase of technology anxiety with using telerehabilitation coupled with their decreased behavioral intention to use telerehabilitation is due to the technology being new, or participants being less experienced in using it. However, participants with vision impairments were noted to have a high composite resistance to change (M = 18.6, SD = 6.0) similar to only the total sample (M = 17.2, SD = 5.4) and the vision rehabilitation professional group (M = 17.1, SD = 4.1). Thus, this data explains participants with vision impairments reporting not having difficulty accessing in-person low vision services, so they have no need to seek out new low vision service delivery options, like telerehabilitation services.

Eye Care Professional Group

Nine people who identified as eye care professionals that work with people who have a moderate to severe vision impairment responded to this survey. All eye care professionals stated that they somewhat to strongly agreed feeling comfortable and skilled using computers, mobile devices, and videoconferencing programs. As previously stated, eye care professionals had a similar average composite score for behavioral intention as the total sample, eye care professional group, and vision rehabilitation professional group. However, the frequencies and percentages of behavioral intention to accept and use low vision telerehabilitation services for the eye care and vision rehabilitation groups were greater than the people with vision impairments group. For instance, on planning to use telerehabilitation in the future, 5 out of 14 eye care professionals (36%) and 8 out of 22 vision rehabilitation professionals (36%) reported slightly to strongly agreeing, whereas only 7 out of 26 people with vision impairments (27%) slightly to strongly agreed. Another example related to planning on using telerehabilitation in their daily lives, 4 out of 12 eye care professionals (33%) and 8 out of 22 vision rehabilitation professionals (36%) slightly to strongly agreed while only 5 out of 26 people with vision impairments (19%) slightly to strongly agreed. Lastly, for planning on using telerehabilitation frequently, 4 out of 12 eye care professionals (33%) and 6 out of 21 vision rehabilitation professionals (29%) slightly to strongly agreed when 4 out of 25 people with vision impairments (16%) slightly to strongly agreed. As discussed earlier, eye care professionals' technology anxiety to use telerehabilitation does not sufficiently explain the larger percentages of behavioral intention, since each group's average technology anxiety composite scores are the same. Rather, the difference in behavioral intention is most likely caused by eye care professionals' lower resistance to change average composite score (M = 13.7, SD = 5.1) compared to the people with vision impairments group (M = 18.6, SD = 6.0), total sample (M = 17.2, SD = 5.4), and the vision rehabilitation professional group (M = 17.1, SD = 4.1). This shows that the eye care professional group is more open to change and more accepting of new technologies than the other groups. Eye care professionals' high comfort and skill level with technology is most likely influenced by the amount of technology they must use daily to perform their job responsibilities. This frequent exposure and use of a variety of technologies, especially technologies that are like telerehabilitation (e.g., videoconferencing programs) may explain their increased behavioral intention to use telerehabilitation. However, caution must be taken with generalizing this data to the whole population of eye care professionals given the small sample size (n = 8).

Vision Rehabilitation Professional Group

Twenty-one people who identified as vision rehabilitation professionals that work with people who have a moderate to severe vision impairment responded to this survey. This group shared similarities with both other groups. The vision rehabilitation group shared similarities with the eye care professional group in their behavioral intention to use telerehabilitation with 8 out of 22 vision rehabilitation professional participants (36%) reporting slightly to strongly agreeing that they planned on using telerehabilitation in the future, 8 out of 22 vision rehabilitation professional participants (36%) noted slightly to strongly agreeing that they planned on using telerehabilitation in their daily lives, and 6 out of 21 vision rehabilitation professional participants (29%) stated slightly to strongly agreeing that they planned on using telerehabilitation frequently. The vision rehabilitation professional group was similar to the people with vision impairments group with most of them being somewhat to very comfortable with using computers (94%), mobile devices (94%), and videoconferencing programs (89%); they also reported being somewhat to very skilled with using computers (94%), mobile devices (100%), and videoconferencing programs (89%). Also, the vision rehabilitation group was similar to the people with vision impairments group in that both groups reported a high level of resistance to change. Therefore, like the people with vision impairments group, the vision rehabilitation professional group appeared to be satisfied with the in-person low vision rehabilitation services that are already being delivered, and may not recognize the need for another service delivery option at this time.

Hypotheses

Hypothesis 1

The purpose of hypothesis 1 was to determine if the collected data for all groups combined supported the relationships between the predictor variables of performance expectancy, effort expectancy, technology anxiety, and resistance to change and the outcome variable of behavioral intention for the study's total sample as depicted by the full proposed UTAUT model (see Chapter 2) with its extensions and adaptations. The statistical analysis supported a portion of the full model with the performance expectancy construct showing a significant small effect size relationship with behavioral intention, and the resistance to change construct also having a small relationship with behavioral intention. This means that those participants who believed that telerehabilitation would help them perform their day-to-day activities better, and those who were not resistant to using new technologies (e.g., telerehabilitation) were likely to accept and plan to use telerehabilitation. Although all of the relationships noted in this study need to be interpreted with caution due to a small sample size, it was interesting to note that the effort expectancy and technology anxiety constructs did not have any noticeable relationships with behavioral intention. Both Davis et al. (1989) and Venkatesh (1999) stated that when initially learning about and how to use a novel technology, such as telerehabilitation, participants would weigh if the amount of effort needed to learn and use the technology was worth planning to accept and use the technology. They further state that as the technology is used participants are not as concerned with the amount of effort required to use the technology.

In their original work, Venkatesh et al. (2003) found that technology anxiety was not a direct determinant of behavioral intention, instead they reported that technology anxiety was fully mediated by effort expectancy. In a more recent study, however, Hoque and Sorwar (2017) found that technology anxiety was conceptually and empirically distinct from the effort expectancy construct. A clear conclusion cannot be drawn regarding the mediation effects of effort expectancy on technology anxiety due to the small sample size and its limited generalizability to the population. As pointed out in the earlier discussion, resistance to change played a larger role, at least for this study, with behavioral intention than the effort expectancy and technology anxiety constructs.

This study also examined if the direct relationships between the predictor variables of performance expectancy, effort expectancy, technology anxiety, and resistance to change and the outcome variable of behavioral intention to use telerehabilitation changed when adjusted for age, gender, and experience. Venkatesh et al. (2003) found that performance expectancy was mediated by age and gender. Although these recommendations were retained for this study's model as possible confounding variables, this study did not find that any of these variables changed the relationship between the predictor variables and the outcome variable.

Hypothesis 2

The purpose of Hypothesis 2 was to examine if a relationship existed between performance expectancy and behavioral intention for each stakeholder group. These results were similar to the those found for Hypothesis 1; that is, a small relationship existed between performance expectancy, or participants believed that telerehabilitation would help them complete their daily tasks, and behavioral intention, or participants' planned acceptance and use of telerehabilitation. According to Venkatesh et al. (2003), performance expectancy is the strongest predictor of behavioral intention, so this small relationship, which could be a result of the study's small sample size, was expected. They also suggested that the relationship between performance expectancy and behavioral intention would be moderated by age with younger people being more willing to accept and use new technologies. This study did not find that age changed the relationship between performance expectancy and behavioral intention, which may be due to the mean age of each group being in the middle adulthood range: people with vision impairments group (M = 45.6), eye care professional group (M = 45.2), and vision rehabilitation professional group (M = 44.7). Gender was also thought to moderate this relationship with men being more likely to use a novel technology that would help them perform their daily tasks more efficiently. This study found that gender only changed the relationship between performance expectancy and behavioral intention for eye care professionals from small to strong. The relationships for people with vision impairments and vision rehabilitation professionals may not have changed when adjusted for gender because each group disproportionately consisted of more females than males: people with vision impairments group (males n = 9, females n = 13), eye care professional group (males n = 3, females n = 6), and vision rehabilitation professional group (males n = 0, females n = 21). Although experience was not originally modeled as a moderator variable of the relationship between performance expectancy and behavioral intention, this study examined whether this relationship was confounded by experience. The only relationship that changed when adjusted for experience was that of eye care professionals, which is questionable due to the study's small sample size. Only three eye care professionals responded to this item. Two reported having 0 – 1 years of experience using telerehabilitation, the other reported having 4 – 5 years of telerehabilitation experience.

Hypothesis 3

The purpose of Hypothesis 3 was to determine if a relationship existed between effort expectancy and behavioral intention for each stakeholder group. One small relationship was found between effort expectancy and behavioral intention for the people with vision impairments group. This means that those participants in this group who felt telerehabilitation was easy to use were likely to accept and plan to use telerehabilitation. This was not the case for the eye care and vision rehabilitation professional groups; in fact, these groups had slight negative correlations, but due to the correlation coefficient being close to zero and the study's overall small sample size the interpretation of an inverse relationship existing between these variables must be taken cautiously. The original UTAUT model demonstrated that the relationship between effort expectancy and behavioral intention were moderated by age, gender, and experience. However, this study's findings did not demonstrate a change in this relationship when adjusting for age, gender, and experience for any stakeholder group. Age, gender, and experience may not be confounding variables to the relationship between effort expectancy and behavioral intention for this study, since the average age is middle adulthood, and the sample having mostly females, and the majority of the sample homogeneously reporting a lot of experience with computers, mobile devices, and videoconferencing programs.

Hypothesis 4

The purpose of Hypothesis 4 was to determine if a relationship existed between technology anxiety and behavioral intention for each stakeholder group. A small relationship between technology anxiety and behavioral intention was observed for eye care professionals. As predicted by Hoque and Sorwar (2017), the eye care professionals that experienced less anxiety about using telerehabilitation were likely to accept and plan to use telerehabilitation. A negative small effect size correlation coefficient was found between technology anxiety and behavioral intention for people with vision impairments which is difficult to interpret given the limited number of survey response. One potential reason for this that was mentioned earlier is that people with vision impairments reported being satisfied with the in-person low vision services they were receiving, so they may not feel the need to seek out additional services. Also, people with vision impairments, at least in this study, were noted to be more resistant to change. According to Hoque and Sorwar (2017), the relationship between technology anxiety and behavioral intention are moderated by age, gender, and experience. For this study, changes in this relationship did not occur when adjusted for age and gender which is most likely due to the reasons already discussed in the previous section. When adjusted for experience, the relationship for the eye care professional group changed from small to moderate which indicates that as the eye care professional's experience with technology increased their anxiety regarding using the technology decreased. No other changes in relationships were noted for other stakeholder groups when adjusted for experience.

Hypothesis 5

The purpose of Hypothesis 5 was to determine if a relationship existed between resistance to change and behavioral intention for each stakeholder group. A small relationship between resistance to change and behavioral intention was observed for eye care professionals. As predicted by Hoque and Sorwar (2017), the vision rehabilitation professionals that were less resistant to change regarding the use of telerehabilitation were likely to accept and plan to use telerehabilitation. No relationship between resistance to change and behavioral intention were found for the other stakeholder groups. Hoque and Sorwar (2017) also found that the relationship between resistance to change and behavioral intention was moderated by age, gender, and experience. When adjusted for age, no changes in the relationship between resistance to change and behavioral intention were noted for any of the groups which is most likely due to reasons previously discussed. When adjusted for gender, the only relationship that changed was for eye care professionals that went from a slight negative correlation coefficient to a negative moderate effect size correlation coefficient. This change suggests that gender has an indirect relationship with resistance to change where one gender is more resistant to change than the other gender which, in turn, changes behavioral intention to accept and plan to use telerehabilitation among people of that gender. When adjusted for experience, the relationship between resistance to change and behavioral intention changed for the eye care professional group from no relationship to a small relationship. This change in the relationship may reflect that only

3 of the eye care professionals that participated in the study reported having experience with telerehabilitation. No other stakeholder groups had a change in the relationship between resistance to change and behavioral intention after adjusting for experience which is possibly due to the reasons previously mentioned.

Limitations

This study had four major limitations: (a) a poor response rate; (b) reliance on individuals who received messages through email or social media to forward it to all people they may know who are eligible to participate; (c) overly stringent inclusion criteria; and (d) issues with the online survey. Despite the attempts of this researcher to recruit a sample that represents the population by utilizing email and social media, only 113 people responded to the request to participate. Out of 113 respondents only 47 (41.6%) completed the entire survey. A larger sample would be more representative of the universe of people that belong to each stakeholder group. The study's small sample size also affects the ability of the research to provide significant findings to support or refute the study's hypotheses. This could be improved by using other methods of contacting potential participants, and by understanding why 58% of the respondents only answered the questions in part one of the survey which may be due to accessibility or inclusion criteria issues. Another way to increase the sample size is to find other means for collecting contact information. The difficulty in finding email addresses for individual eye care and vision rehabilitation professionals through web searches limited the number of individuals that could be directly recruited to participate. Polit and Beck (2012) and Dillman et al. (2014) state that poor response rates are common with surveys, but especially for online surveys.

A second limitation was that the online format of the study's survey artificially skewed the data by not being available for people who do not use the Internet. Also, those who responded to the survey were already comfortable and skilled with using technology, so this study was not able to collect data on people who did not have access to the internet or were not proficient in using computers or mobile devices. Additionally, the study relied on the goodwill of individuals who received an email or social media message to forward it to other people who might have been eligible to participate in the study. For instance, this researcher sent email messages to directors of vocational rehabilitation agencies that serve people with vision impairments. The email message asked them to feel free to share the email with anyone who meets the inclusion criteria. This researcher has no way of knowing that this specific request in the email was read, or if the email reached the intended recipient due to spam filters, or who, if anyone, the director forwarded the email message to. Similarly, social media messages relied on people checking their feeds and passing the survey along to others. Thus, it was impossible to know how many people the survey reached.

The third limitation of the study is overly stringent inclusion criteria. This limitation particularly addresses the inclusion criteria established for eye care and vision rehabilitation professionals to ensure they routinely work with people who have moderate to severe vision impairments. To achieve this expectation, the inclusion criteria required ophthalmologists to be certified by the American Board of Ophthalmology, and optometrists to be fellows of the American Academy of Optometry. This may explain why 9 eye care professionals began the survey, but did not finish it. One optometrist sent this researcher an email message stating "it is unfortunate that your survey doesn't allow input from ODs who are not members of the Academy of Optometry. It is my experience that most ODs are not members of this group, which derives the bulk of its membership from those working at Optometry Schools or institutional/hospital settings. As such, you are missing out on opinions from, dare I say, the bulk of ODs providing low vision care in this country.” Although this researcher did not receive any similar responses from ophthalmologists, it is probable that several ophthalmologists were also not able to participate in the survey as a result of these stringent criteria.

The fourth limitation involves issues related to the online survey. Before beginning to distribute the survey, the researcher pilot tested the online survey interface on people with vision impairments and the professionals who work with them. The survey interface was not accessible to participants who had a vision impairment, especially those who were totally blind. The researcher switched the online survey interface to Qualtrics which reportedly is accessible to people with vision impairments. However, this researcher received an email from one participant who was totally blind which stated “I attempted your survey. I am totally blind, so I did not check the box for the question about visual acuity. Something about check the box if you have visual acuity of 20/60. This ended the survey for me. I am thinking you meant that to say visual acuity of 20/60 or less”. This question and others used the less than, “<”, and greater than, “>”, symbols instead of the words which made it difficult for people who are totally blind to correctly answer the survey. Although this is the only issue that was directly pointed out by the participants, there are probably other issues with the online survey that made it problematic for people with vision impairments. This may explain why 8 people with vision impairments did not complete the survey, or why 23 people began the survey but did not answer any questions.

Limitations of this study involve poor response rates, single survey response method, stringent inclusion criteria, and accessibility issues. A future study could address these limitations in several ways: (1) expanding the recruitment procedure to include distributing flyers in eye care and vision rehabilitation agencies and clinics; (2) using multiple forms of data collection, such as paper surveys or providing an option for a survey to be conducted over the telephone; (3) relaxing the inclusion criteria to include more eye care and vision rehabilitation professionals; and (4) providing alternative methods for data collection if accessibility is an issue.

Applications

Bittner et al. (2020) found no available evidence to support the use of telerehabilitation for people with vision impairments. Chapter 2 provides preliminary evidence through observational and small sample size studies that support the potential benefit and feasibility of using telerehabilitation to deliver low vision rehabilitation services. However, they state a necessary first step in this line of inquiry is investigating preferences for receiving services via telerehabilitation among people with vision impairments. This study attempted this by using an adapted and expanded version of the UTAUT model, and investigating the underlying factors that impact three stakeholder groups' acceptance and planned use (i.e., behavioral intention) of telerehabilitation as a low vision service delivery option. The underlying constructs that were tested for this study were performance expectancy, effort expectancy, technology anxiety, and resistance to change. A better understanding of these factors and their relationship to behavioral intention to use telerehabilitation will provide direction in where to start with expanding access to low vision telerehabilitation services and establishing a long-term feasibility plan.

Currently, this study found that only 21 participants (45%) in this study reported using telerehabilitation, and only 20 participants (43%) plan on using telerehabilitation in the future. This is the first study to examine the underlying factors that are related to all three stakeholder groups' behavioral intention to use telerehabilitation. These factors have been studied to determine behavioral intention to accept and use new technology in other practice settings and with other populations. Thus, this study adds to the body of knowledge in this area related to the low vision rehabilitation setting.

Clinical Implications

The success telerehabilitation has had in other areas of practice and with other populations provides a promising outlook for using this modality to provide low vision rehabilitation services. Telerehabilitation has the potential to increase the access and utilization of services while increasing clients' independence in everyday living tasks and decreasing the burden placed upon caregivers and society. This study provides preliminary information that can be used in future studies that seek to understand why different stakeholder groups choose to accept and plan to use telerehabilitation. Once this information is better understood, researchers can build upon this information to increase the actual use of telerehabilitation among all three stakeholder groups.

Another clinical implication that occurred during this study that expanded the use of telehealth and telerehabilitation technology is the novel Coronavirus (COVID-19). Andrews et al. (2020) and Thomas et al. (2020) found that the pandemic increased the demands of social distancing to reduce transmission of the virus, and, at the same time, increased the need for many clinicians and clients to use telehealth technology to connect with one another. Thus, in many instances, it was mandatory for people to use this technology to get the services and care they needed, which forced them to learn how to use it, and may explain why some people report feeling more comfortable and skilled with using this type of technology.

Recommendations for Future Studies

This study builds upon telerehabilitation research that has been conducted in other settings and with other populations. Since this is the first study that addresses three stakeholder groups' behavioral intention to use telerehabilitation services as a low vision service delivery option, this study with a larger sample size should be replicated. Future replication studies may also consider expanding on other UTAUT constructs that are related to the stakeholders' behavioral intention to use telerehabilitation. This exploratory research can also be used to guide future studies related to the implementation and use of telerehabilitation in low vision rehabilitation practice during evaluation, intervention, and discharge while considering its economic, educational, and cultural impact. Other future studies on the use of telerehabilitation in low vision should address timing of implementation (i.e., during evaluation, intervention, and discharge), effectiveness of telerehabilitation tools, and dosing of telerehabilitation (i.e., how much can telerehabilitation be used in conjunction with face-to-face low vision rehabilitation services).

As discussed in the limitations section, future studies should be designed to address poor response rate by utilizing a variety of recruitment strategies that include distributing flyers to eye care and vision rehabilitation professionals' agencies or clinics or recruiting at professional and consumer conferences that target these three stakeholder groups. A future study should use multiple methods for data collection including paper and pencil as well as telephone interviews. The next study should also relax the inclusion criteria, so people are not excluded unnecessarily. Lastly, a study should have alternate formats that are more accessible to people that use any type of assistive technology device. This may include allowing participants to answer the questions in-person or over the telephone.

Besides these general recommendations for future studies that address this study's limitations, future studies should specifically focus on researching each stakeholder group's behavioral intention to use telerehabilitation. This study identified that each stakeholder group was unique in its reasons to plan, or not to plan, to use telerehabilitation in the future. The group that I would start with would be eye care professionals because these professionals are the gatekeepers to other services and professionals (e.g., telerehabilitation and low vision rehabilitation professionals), and often the clients first contact with low vision services. So, the success of using telerehabilitation as a low vision service delivery option for the other two stakeholder groups (i.e., vision rehabilitation professionals and people with vision impairments) depends on the behavioral intention of the eye care professional stakeholder group to use and promote telerehabilitation as a service delivery option. By researching the behavioral intention of each stakeholder group separately researchers would be able to ask questions that specifically pertain to each group. For example, questions that impact eye care professionals' decisions to plan to use telerehabilitation may be concerned with third party payer reimbursement. Questions that affect the decision of people with vision impairments to plan to use telerehabilitation may focus more on the availability of telerehabilitation technology in their geographical area.

This pilot study specifically addressed the people in each stakeholder groups' intrinsic factors that influenced their behavioral intention to use telerehabilitation as a low vision service delivery option. Future studies should also research the extrinsic factors that impact the various stakeholder groups' behavioral intention to use telerehabilitation. Some of these extrinsic factors include medical insurance reimbursement of telerehabilitation, federal and state policies that support the use of telerehabilitation, and availability of telerehabilitation technology for the provision of low vision rehabilitation services.

Conclusion

Millions of people in the United States are negatively impacted by vision loss. This impact affects their ability to independently perform everyday living tasks as well as places a burden on caregivers and society (National Center for Chronic Disease Prevention and Health Promotion, 2011). Some people may be able to adapt to or compensate for these deficits, but many others require services to overcome their challenges caused by low vision. However, the access and utilization of these services are quite poor around the world, even in developed countries. One service delivery option that has been used in other settings and with other populations to increase the access and use of rehabilitation services is telerehabilitation. Telerehabilitation services allow the clinician to remotely provide services to clients where they live, work, and play. The use of telerehabilitation to deliver low vision rehabilitation services is still in its infancy where only a few small sample size studies discuss the use and satisfaction with these services.

The first step that needs to be taken in this area is investigating people's intentions to use telerehabilitation before expending considerable amount of time, effort, and resources to develop this technology and expand these services. This study addressed this by examining the underlying factors of three stakeholder groups' behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option. This study used a pre-validated online survey based on an adapted and expanded version of the UTAUT model to collect data regarding these underlying factors. Forty-seven participants completed the survey which consisted of people with vision impairments, eye care professionals, and vision rehabilitation professionals. Performance expectancy and resistance to change were the two underlying factors that had a relationship with behavioral intention to use telerehabilitation as a low vision rehabilitation service delivery option. Age, gender, and experience were noted to change some of the relationships between the predictor variables and the outcome variable for one or more of the stakeholder groups. This chapter provided discussion of the relationship between the underlying factors and behavioral intention to use telerehabilitation for each stakeholder group. Due to the small sample size the results are limited and cannot be generalized to the vision impairment community as a whole.

This study is the first to explore the underlying factors related to behavioral intention of three stakeholder groups to use telerehabilitation as a low vision rehabilitation service delivery option. The applications, limitations, and implications of this study were addressed in this chapter, along with recommendations for future survey-based studies investigating this technology within the low vision community.

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Appendix 1: Survey

Intentions to Use Telerehabilitation for Communication and Treatment for Vision Impairments

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Start of Block: Welcome_Intro

Survey Intro **WELCOME!   You have been invited to participate in a doctoral research study entitled "Intentions to Use Telerehabilitation for Communication and Treatment for Vision Impairments." This anonymous survey explores the likelihood of using telerehabilitation to improve the access and use of low vision rehabilitation services. Your responses should be based on the description of telerehabilitation systems provided below and any previous knowledge of telerehabilitation you might have.   The survey has eight (8) sections. Your input on each of these questions is valuable to finding new solutions to increasing the access and use of low vision rehabilitation services by people with vision impairments. Your participation in this survey is voluntary, and the estimated time to complete the survey should be between 15 and 20 minutes.**

Thank you for participating in this doctoral research study! Your input is greatly appreciated. If you experience any technical difficulties or have any questions regarding the study, please contact: Eric Hicks, MS, OTR/L at hicksee@vcu.edu, or (352) 246-9578.

End of Block: Welcome_Intro

Start of Block: Intro_Question

Intro Choice **The questions in this survey try to find out how likely eye care professionals, vision rehabilitation professionals, and people with vision impairments (VI) are to use telerehabilitation for low vision rehabilitation services.**

Telerehabilitation is the use of a computer or mobile device, like a mobile phone, tablet, or iPad, to deliver rehabilitation services. This is similar to a rehabilitation professional in a clinic using Facetime or Skype to see, communicate, and work with a person in the person's home or work.

When filling out the survey some people may belong to more than one group, like a vision

rehabilitation professional who is also a person with a vision impairment. So, this first question asks you to choose which group you want to represent when filling out this survey.

Intro_001 **When answering the questions in this survey which group will you be representing? (Choose only one option)**

- ◯ As a person with a vision impairment (1)
- ◯ As an eye care professional (i.e., ophthalmologist or optometrist) (2)
- ◯ As a vision rehabilitation professional (i.e., low vision therapist, occupational therapist, orientation and mobility instructor, vision rehabilitation therapist, or vocational rehabilitation counselor) (3)

End of Block: Intro_Question

Start of Block: Inclusion Criteria

Inclusion Criteria **This section asks questions to find out if you meet the criteria needed to participate in this survey.**

Inclusion_001 **Do you currently practice at least part-time in the United States?**

- ◯ Yes (1)
- ◯ No (2)

Inclusion_002 **Are you currently licensed or registered as a MD or Doctor of Optometry in the state where you practice?**

- Yes (1)
- No (2)

Inclusion_003 **Do you currently treat people who have a visual acuity of < 20/60, or a central visual field of < 20 degrees?**

- Yes (1)
- No (2)

Inclusion_004 **Are you an ophthalmologist certified by the American Board of Ophthalmology, or are you an optometrist who is a fellow of the American Academy of Optometry?**

- Yes (1)
- No (2)

Inclusion_005 **Do you currently work with people who have a visual acuity of < 20/60, or a central visual field of < 20 degrees?**

- Yes (1)
- No (2)

Inclusion_006
Are you currently certified by the Academy for Certification of Vision Rehabilitation &

Education Professionals (ACVREP) as a Certified Low Vision Therapist (CLVT), Certified Vision Rehabilitation Therapist(CVRT), and/or Certified Orientation and Mobility Specialist?

-OR-

Are you a licensed occupational therapist in the state you practice and have a specialty certification in low vision from the American Occupational Therapy Association (AOTA)?

- ◯ Yes (1)
- ◯ No (2)

Inclusion_007 **Do you currently live at least part time in the United States?**

- ◯ Yes (1)
- ◯ No (2)

Inclusion_008 **Are you 18 years of age or older?**

- ◯ Yes (1)
- ◯ No (2)

Inclusion_009 **Do you have an eye condition or disease that results in a visual acuity of less than 20/60, or a central visual field of less than 20 degrees?**

- ◯ Yes (1)
- ◯ No (2)

End of Block: Inclusion Criteria

Start of Block: Demographics

Demographics **The purpose of this section is to gather basic information to help analyze the survey's results.**

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*

Age_001 **Please enter your age in years:**

____

Gender_001 **What is your gender?**

- Male (1)
- Female (2)
- Other (3)

Gender_002 **Please write your gender in the box below:**

____

Vis_Type_001 **What is the name of your vision condition or impairment?**

____

Visimp_exp_001 **How many years have you had this vision condition or impairment?**

- ◯ 0 - 5 years (1)
- ◯ 6 - 10 years (2)
- ◯ 11 - 15 years (3)
- ◯ 16 - 20 years (4)
- ◯ 20+ years (5)

Visimp_exp_002 **Which of the following statements best describe your vision condition?**

- ◯ My best corrected visual acuity is less than 20/60 (1)
- ◯ My best corrected visual acuity is less than 20/160, or my visual field is 20 degrees or less (2)
- ◯ My best corrected visual acuity is less than 20/400, or my visual field is 10 degrees or less (3)
- ◯ My best corrected visual acuity is less than 20/1000, or my visual field is 5 degrees or less (4)
- ◯ I have no light perception (5)

Visimp_exp_003 **How stable is your eye condition?**

- ◯ Not stable at all (1)
- ◯ Somewhat stable (2)
- ◯ Very stable (3)

Visimp_exp_004 **Have you ever received services because of your vision condition?**

- ○ Yes (1)
- ○ No (2)

Visimp_exp_005 **Which services have you received for your vision impairment? (Choose all that apply)**

- ☐ Low vision therapy (1)
- ☐ Occupational therapy (2)
- ☐ Orientation and mobility (3)
- ☐ Vision rehabilitation (4)

---

*

Visimp_exp_006 **How many times have you received low vision therapy services for your vision impairment?**

____

Visimp_exp_007 **How difficult was it to schedule your low vision therapy sessions?**

- ◯ Not difficult at all (1)
- ◯ A little difficult (2)
- ◯ Somewhat difficult (3)
- ◯ Very difficult (4)

Visimp_exp_008 **How difficult was it to make it to your low vision therapy sessions?**

- ◯ Not difficult at all (1)
- ◯ A little difficult (2)
- ◯ Somewhat difficult (3)
- ◯ Very difficult (4)

---

*

Visimp_exp_009 **How many times have you received occupational therapy services for your vision impairment?**

____

Visimp_exp_010 **How difficult was it to schedule your occupational therapy sessions?**

- ○ Not difficult at all (1)
- ○ A little difficult (2)
- ○ Somewhat difficult (3)
- ○ Very difficult (4)

Visimp_exp_011 **How difficult was it to make it to your occupational therapy sessions?**

- ○ Not difficult at all (1)
- ○ A little difficult (2)
- ○ Somewhat difficult (3)
- ○ Very difficult (4)

---

*

Visimp_exp_012 **How many times have you received orientation and mobility services for your vision impairment?**

____

Visimp_exp_013 **How difficult was it to schedule your orientation and mobility sessions?**

- Not difficult at all (1)
- A little difficult (2)
- Somewhat difficult (3)
- Very difficult (4)

Visimp_exp_014 **How difficult was it to make it to your orientation and mobility sessions?**

- Not difficult at all (1)
- A little difficult (2)
- Somewhat difficult (3)
- Very difficult (4)

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Visimp_exp_015 **How many times have you received vision rehabilitation services for your vision impairment?**

____

Visimp_exp_016 **How difficult was it to schedule your vision rehabilitation sessions?**

- ○ Not difficult at all (1)
- ○ A little difficult (2)
- ○ Somewhat difficult (3)
- ○ Very difficult (4)

Visimp_exp_017 **How difficult was it to make it to your vision rehabilitation sessions?**

- ○ Not difficult at all (1)
- ○ A little difficult (2)
- ○ Somewhat difficult (3)
- ○ Very difficult (4)

Visimp_exp_018 **Which of the following best describes the area in which you live?**

- ○ Rural (1)
- ○ Suburban (2)
- ○ Urban (3)

Eyeprof_exp_001 **How many people do you see that have a vision impairment with a visual acuity of 20/60 or less, or a central visual field of 20 degrees or less during a typical week?**

____

Eyeprof_exp_002 **Which eye care professional discipline best describes you?**

- ◯ Ophthalmologist (1)
- ◯ Optometrist (2)

Eyeprof_exp_003 **Which of the following best describes the area in which you work?**

- ◯ Rural (1)
- ◯ Suburban (2)
- ◯ Urban (3)

Visprof_exp_001 **Do you also have a vision impairment?**

- ◯ Yes (1)
- ◯ No (2)

Visprof_exp_002 **What is the name of your vision condition or impairment?**

____

Visprof_exp_003 **How many years have you had this vision condition or impairment?**

- 0 - 5 years (1)
- 6 - 10 years (2)
- 11 - 15 years (3)
- 16 - 20 years (4)
- 20+ years (5)

Visprof_exp_004 **Which of the following statements best describe your vision condition?**

- My best corrected visual acuity is less than 20/60 (1)
- My best corrected visual acuity is less than 20/160, or my visual field is 20 degrees or less (2)
- My best corrected visual acuity is less than 20/400, or my visual field is 10 degrees or less (3)
- My best corrected visual acuity is less than 20/1000, or my visual field is 5 degrees or less (4)
- I have no light perception (5)

Visprof_exp_005 **Which of the following vision rehabilitation professional disciplines describe you? (Choose all that apply)**

- ◯ Low vision therapist (1)
- ◯ Occupational therapist (2)
- ◯ Orientation and mobility specialist (3)
- ◯ Vision rehabilitation therapist (4)
- ◯ Vocational rehabilitation counselor (5)

Visprof_exp_006 **How many years of experience do you have as a professional that works with people who have a vision impairment?**

- ◯ 0 - 5 years (1)
- ◯ 6 - 10 years (2)
- ◯ 11 - 15 years (3)
- ◯ 16 - 20 years (4)
- ◯ 20+ years (5)

Visprof_exp_007 **How many clients do you see a week?**

____

Visprof_exp_008 **Do you have to commute to your clients' homes to provide services related to their vision impairments?**

◯ Yes (1)

◯ No (2)

Visprof_exp_009 **On average, how many miles do you have to travel to see clients?**

____

Visprof_exp_010 **Which of the following best describes the area in which you work?**

◯ Rural (1)

◯ Suburban (2)

◯ Urban (3)

---

tr_use_001 **Have you ever used telerehabilitation?**

◯ Yes (1)

◯ No (2)

---

tr_use_002 **How many years have you used telerehabilitation?**

- 0 - 1 years (1)
- 2 - 3 years (2)
- 4 - 5 years (3)
- 6 - 7 years (4)
- 8 - 9 years (5)
- 10 years or more (6)

End of Block: Demographics

Start of Block: Behavioral Intention

BI_001 **I plan to use telerehabilitation in the future**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

BI_002 **I will try to use telerehabilitation in my daily life**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

BI_003 **I plan to use telerehabilitation frequently**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

End of Block: Behavioral Intention

Start of Block: Performance Expectancy

PE_Intro
The questions in this section try to find out how much you believe using a telerehabilitation system will improve the ability of a person with a vision impairment (VI) to complete everyday tasks.

Please choose how much you agree or disagree with each of the items that complete the following sentence:
"Based on the description provided and my understanding of telerehabilitation, I think a telerehabilitation system would . . ."

PE_001 **Be useful in helping people with visual impairments accomplish their goals more quickly**

- ◯ Strongly disagree (1)
- ◯ Somewhat disagree (2)
- ◯ Slightly disagree (3)
- ◯ Neither agree nor disagree (4)
- ◯ Slightly agree (5)
- ◯ Somewhat agree (6)
- ◯ Strongly agree (7)
- ◯ Don't know (8)

PE_002 **Improve performance of everyday tasks in people with visual impairments**

- ◯ Strongly disagree (1)
- ◯ Somewhat disagree (2)
- ◯ Slightly disagree (3)
- ◯ Neither agree nor disagree (4)
- ◯ Slightly agree (5)
- ◯ Somewhat agree (6)
- ◯ Strongly agree (7)
- ◯ Don't know (8)

PE_003 **Improve the success of treatment provided to people with visual impairments**

- ◯ Strongly disagree (1)
- ◯ Somewhat disagree (2)
- ◯ Slightly disagree (3)
- ◯ Neither agree nor disagree (4)
- ◯ Slightly agree (5)
- ◯ Somewhat agree (6)
- ◯ Strongly agree (7)
- ◯ Don't know (8)

PE_004 **Increase the quality of services provided to people with visual impairments**

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Slightly disagree (3)
- ○ Neither agree nor disagree (4)
- ○ Slightly agree (5)
- ○ Somewhat agree (6)
- ○ Strongly agree (7)
- ○ Don't know (8)

PE_005 **Make it easier for people with visual impairments to receive treatment or rehabilitation**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

End of Block: Performance Expectancy

Start of Block: Effort Expectancy

EE_Intro
These next questions try to find out how easy or difficult you think using a telerehabilitation system would be.

Please choose how much you agree or disagree with each of the items that complete the following sentence:
"Based on the description provided and my understanding of telerehabilitation, I would find a telerehabilitation system . . ."

EE_001 **Easy to learn how to operate**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

EE_002 **Easy to use**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

EE_003 **Easy to understand**

- ◯ Strongly disagree (1)
- ◯ Somewhat disagree (2)
- ◯ Slightly disagree (3)
- ◯ Neither agree nor disagree (4)
- ◯ Slightly agree (5)
- ◯ Somewhat agree (6)
- ◯ Strongly agree (7)
- ◯ Don't know (8)

EE_004 **To not take a long time to learn how to use**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

EE_005 **Easy to get it to do what I want it to do**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

End of Block: Effort Expectancy

Start of Block: Technology Anxiety

TA_Intro
The questions in this section ask about how nervous or anxious you may be if you used a telerehabilitation system.

Please choose how much you agree or disagree with each of the items that complete the following sentence:
"Based on the description provided and my understanding of telerehabilitation, a telerehabilitation system would make me feel . . ."

TA_001 **Nervous**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

TA_002 **Uncomfortable**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

TA_003 **Confused**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

TA_004 **Intimidated**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

TA_005 **Like I could "mess it up" by hitting the wrong button or key**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

End of Block: Technology Anxiety

Start of Block: Resistance To Change

RC_Intro
These questions try to find out how likely and willing you would be to use a telerehabilitation system.

Please choose how much you agree or disagree with each of the items that complete the following sentence:
"Based on the description provided and my understanding of telerehabilitation, I think using a telerehabilitation system would negatively change the way . . ."

RC_001 **I deal with my vision related problems**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

RC_002 **I work with my patients' vision related problems**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

RC_003 **I work with my clients' vision related problems**

- 7, Strongly disagree (1)
- 6, Somewhat disagree (2)
- 5, Slightly disagree (3)
- 4, Neither agree nor disagree (4)
- 3, Slightly agree (5)
- 2, Somewhat agree (6)
- 1, Strongly agree (7)
- 8, Don't know (8)

RC_004 **I keep myself healthy**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

RC_005 **My patients keep themselves healthy**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

RC_006 **My clients keep themselves healthy**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

RC_007 **I interact with my eye care and vision rehabilitation professionals**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

RC_008 **I interact with my patients**

- Strongly disagree (1)
- Somewhat disagree (2)
- Slightly disagree (3)
- Neither agree nor disagree (4)
- Slightly agree (5)
- Somewhat agree (6)
- Strongly agree (7)
- Don't know (8)

RC_009 **I interact with my clients**

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Slightly disagree (3)
- ○ Neither agree nor disagree (4)
- ○ Slightly agree (5)
- ○ Somewhat agree (6)
- ○ Strongly agree (7)
- ○ Don't know (8)

RC_010 **Overall, using a telerehabilitation system will negatively change the way I currently live**

○ Strongly disagree (1)

○ Somewhat disagree (2)

○ Slightly disagree (3)

○ Neither agree nor disagree (4)

○ Slightly agree (5)

○ Somewhat agree (6)

○ Strongly agree (7)

○ Don't know (8)

RC_011 **Overall, using a telerehabilitation system will negatively change the way I currently practice as an eye care professional**

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Slightly disagree (3)
- ○ Neither agree nor disagree (4)
- ○ Slightly agree (5)
- ○ Somewhat agree (6)
- ○ Strongly agree (7)
- ○ Don't know (8)

RC_012 **Overall, using a telerehabilitation system will negatively change the way I currently practice as a vision rehabilitation professional**

- ◯ Strongly disagree (1)
- ◯ Somewhat disagree (2)
- ◯ Slightly disagree (3)
- ◯ Neither agree nor disagree (4)
- ◯ Slightly agree (5)
- ◯ Somewhat agree (6)
- ◯ Strongly agree (7)
- ◯ Don't know (8)

RC_013 **Most often, I have a "tried and true" way that I like to do things rather than trying a new and different way**

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Slightly disagree (3)
- ○ Neither agree nor disagree (4)
- ○ Slightly agree (5)
- ○ Somewhat agree (6)
- ○ Strongly agree (7)
- ○ Don't know (8)

End of Block: Resistance To Change

Start of Block: Tech Comfort

Tech_Comf_Intro **These last questions ask about your comfort and skill level with technology, like computers and mobile devices.**

Tech_Comf_001 **How comfortable are you with using computers?**

- ○ Not at all comfortable (1)
- ○ A little comfortable (2)
- ○ Somewhat comfortable (3)
- ○ Very comfortable (4)

Tech_Comf_002 **How comfortable are you with using mobile devices, like mobile phones and tablets?**

- Not at all comfortable (1)
- A little comfortable (2)
- Somewhat comfortable (3)
- Very comfortable (4)

Tech_Comf_003 **How comfortable are you with using videoconferencing programs, like Facetime, Skype, and Facebook Messenger?**

- Not at all comfortable (1)
- A little comfortable (2)
- Somewhat comfortable (3)
- Very comfortable (4)

Tech_Comf_004 **How skilled are you with using computers?**

- Not at all skilled (1)
- A little skilled (2)
- Somewhat skilled (3)
- Very skilled (4)

Tech_Comf_005 **How skilled are you with mobile devices?**

- Not at all skilled (1)
- A little skilled (2)
- Somewhat skilled (3)
- Very skilled (4)

Tech_Comf_006 **How skilled are you with using videoconferencing programs, like Facetime, Skype, and Facebook Messenger?**

- Not at all skilled (1)
- A little skilled (2)
- Somewhat skilled (3)
- Very skilled (4)

Tech_Comf_007 **Which of the following do you use to send and receive emails? (Choose all that apply)**

- ☐ computer / laptop (1)
- ☐ mobile phone (2)
- ☐ tablet (3)
- ☐ I do not have an email account (4)

Tech_Comf_008 **Which of the following do you use to search the internet? (Choose all that apply)**

- ☐ computer / laptop (1)
- ☐ mobile phone (2)
- ☐ tablet (3)
- ☐ I never or almost never get on the Internet (4)

Tech_Comf_009 **Which of the following do you use to write letters and documents? (Choose all that apply)**

- ☐ computer / laptop (1)
- ☐ mobile phone (2)
- ☐ tablet (3)
- ☐ I do not write letters or other documents on a computer or mobile device (4)

Tech_Comf_010 **How many years have you been using a computer in your home or at work?**

- ○ 0 years (1)
- ○ 1 - 5 years (2)
- ○ 6 - 10 years (3)
- ○ 11 - 15 years (4)
- ○ 15 - 20 years (5)
- ○ 21 or more years (6)

Tech_Comf_011 **How many years have you been using a mobile device (i.e., mobile phone or tablet) in your home or at work?**

- ○ 0 years (1)
- ○ 1 - 5 years (2)
- ○ 6 - 10 years (3)
- ○ 11 - 15 years (4)
- ○ 15 - 20 years (5)
- ○ 21 or more years (6)

End of Block: Tech Comfort

Appendix 2: Summary of Two Vision Rehabilitation Service Delivery Models

Table begins on next page.

Summary of Two Vision Rehabilitation Service Delivery Models

Rehabilitation model	Funding	Where services are provided	Practitioners	Education & credentials	Services provided
Medical Rehabilitation Model	• Private health insurance • Medicare	• Private ophthalmologist office • Private optometrist office • Hospital • Outpatient clinic • Client's home (provided by homecare agencies) • Comprehensive outpatient rehabilitation facilities	Ophthalmologist	Education: • 4 years of medical or osteopathy school • 1 year internship • Minimum of 3 years residency in ophthalmology • May spend an additional 1 – 2 years in a subspecialty • Obtain either a Doctor of Medicine (M.D.) or Doctor of Osteopathy (D.O) degree Credentials • State license as an M.D., or D.O. • Specialization in low vision	• Evaluation of eye disease • Ocular examination • Assessment of visual function • Prescription of optical devices • Recommendation of non-optical devices
			Optometrist	Education: • 4 year post-graduate program in optometry • May spend an additional 1 – 2	• Ocular examination • Assessment of visual function • Prescription of optical devices • Recommendation of non-optical devices

Rehabilitation model	Funding	Where services are provided	Practitioners	Education & credentials	Services provided
				years in a subspecialty • Obtain a Doctor of Optometry (O.D.) degree Credentials • State license as an optometrist • Specialization in low vision	• Training in the use of optical aids and other devices • Introduction to local and national resources and services
			Low vision therapist	Education: • Minimum of a Bachelor's degree with an emphasis in low vision therapy • Completion of 350 hours of discipline specific supervised internship Credentials • Certified by the Academy for Certification of Vision Rehabilitation and Education Professionals (ACVREP)	• Training in the use of optical aids and other non-optical devices during activities of daily living • Training in adaptive skills for performing everyday activities • Training in eccentric viewing • Training in computer and accessible technology, including enlargement and speech output • Introduction to local and national resources and services • Training and support for caregivers
			Occupational therapist	Education: • Minimum post-graduate master's	• Training in the use of optical aids and other

Rehabilitation model	Funding	Where services are provided	Practitioners	Education & credentials	Services provided
				program in occupational therapy • Obtain a Master's of Occupational Therapy (M.O.T) Degree, or a Doctor of Occupational Therapy (O.T.D.) degree Credentials • State license as an occupational therapist • Initially certified by the National Board for Certification in Occupational Therapy (NBCOT) • May obtain a low vision specialty certification from the American Occupational Therapy Association (AOTA)	devices during activities of daily living • Training in adaptive skills for performing everyday activities • Training in eccentric viewing • Driving evaluation and rehabilitation • Assessment and adaptation of home environment • Training in computer and accessible technology, including enlargement and speech output • Vocational training • Training in recreational activities • Introduction to local and national resources and services • Training and support for caregivers
			Psychologist	Education: • Minimum post-graduate master's program in psychology	• Counseling services • Emotional and psychological adjustment to disability

Rehabilitation model	Funding	Where services are provided	Practitioners	Education & credentials	Services provided
				• Obtain a Master's Degree in Psychology, Clinical Psychology Degree (Psy.D), or Doctor of Philosophy Degree (Ph.D.) in Psychology Credentials • State license as a psychologist • Requires board certification to practice as a psychologist	• Emotional and psychological support for caregivers • Introduction to local and national resources and services
			Social worker	Education: • Minimum bachelor's program in social work • Obtain a Bachelor's in Social Work (B.S.W) Degree, Master's in Social Work (M.S.W) Degree, Doctor of Philosophy Degree (Ph.D.) in Social Work Credentials • State license as a social worker	• Counseling services • Emotional and psychological adjustment to disability • Emotional and psychological support for caregivers • Introduction to local and national resources and services

Rehabilitation model	Funding	Where services are provided	Practitioners	Education & credentials	Services provided
				• Requires board certification to practice as a social worker	
Education Model	• State and federal government funding of state agencies that disburse funds to non-profit agencies and private contractors that provide services to the visually impaired • Private funding (e.g., charitable donations) to private non-profit agencies that provide services to	• Non-profit agency clinic setting • Client's home (provided by a non-profit agency) • Community (e.g., grocery store) • Client's workplace	Vocational rehabilitation counselor	Education: • Minimum post-graduate master's program in vocational rehabilitation counseling • Obtain a Master's Degree in Vocational Rehabilitation Counseling, or Doctor of Philosophy Degree (Ph.D.) in Vocational Rehabilitation Counseling Credentials • Some states require vocational rehabilitation counselors to be licensed • Requires board certification to practice as a	• Case management services • Vocational counseling and training • Emotional and psychological adjustment to disability • Introduction to local and national resources and services • Training and support for caregivers

Rehabilitation model	Funding	Where services are provided	Practitioners	Education & credentials	Services provided
	the visually impaired			vocational rehabilitation counselor	
			Vision rehabilitation therapist	Education: • Minimum of a Bachelor's degree with an emphasis in vision rehabilitation therapy • Completion of 350 hours of discipline specific supervised internship Credentials • Certified by the Academy for Certification of Vision Rehabilitation and Education Professionals (ACVREP)	• Performs functional vision assessment • Training in the use of optical aids and other devices during activities of daily living • Training in adaptive skills for performing everyday activities • Assessment and adaptation of home environment • Training in computer and accessible technology, including enlargement and speech output • Vocational training • Training in recreational activities • Introduction to local and national resources and services • Training and support for caregivers

Orientation and mobility specialist	Education: • Minimum of a Bachelor's degree with an emphasis in orientation and mobility • Completion of 350 hours of discipline specific supervised internship Credentials • Certified by the Academy for Certification of Vision Rehabilitation and Education Professionals (ACVREP)	• Performs functional vision assessment • Assessment of safe mobility in the home and community, including the use of support and long canes as well as sunglasses for glare and monoculars for orientation and spotting • Training in safe mobility around the home and in the community, including the use of support and long canes as well as sunglasses for glare and monoculars for orientation and spotting • Driving evaluation and rehabilitation • Introduction to local and national resources and services • Training and support for caregivers

Note: Information was compiled from Berger (2013), Owsley et al. (2009), and Mogk & Goodrich (2004)

Appendix 3: Permission to Use Figure 2

VCU

Eric Hicks <hicksee@vcu.edu>

Permission to use published work

Carry Koolbergen <C.Koolbergen@iospress.nl> Mon, Apr 26, 2021 at 1:57 AM
To: Eric Hicks <hicksee@mymail.vcu.edu>

DOI: 10.3233/WOR-2011-1149
Citation: Work, vol. 39, no. 1, pp. 37-48, 2011

Dear Eric Hicks,

We hereby grant you permission to use the below mentioned material in **print and electronic format** at no charge subject to the following conditions:

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Yours sincerely

Carry Koolbergen (Mrs.)

Appendix 4: Email Recruitment Letter

VCU
College of Health Professions

Dear Prospective Participant,

My name is Eric Hicks. I am a student in the Ph.D in Health Related Sciences program at Virginia Commonwealth University. I am conducting a survey under the direction of my advisor Tony Gentry, Ph.D., OTR/L entitled "Intentions to Use Telerehabilitation for Communication and Treatment for Vision Impairments." This survey is about the behavioral intention of people with vision impairments and the professionals who work with them to accept and use telerehabilitation as a supplement to in-person low vision rehabilitation services. To participate, you must be 18 years or older. The link to access this online survey, which is voluntary, is below.

https://bit.ly/3d21R4m

Since your answers are to remain anonymous, PLEASE DO NOT PUT YOUR NAME ON THIS SURVEY.

Your participation in this survey is anonymous and will take approximately 15 - 20 minutes to complete. Please answer the questions to your comfort level.

The results will be reported for the group of respondents as a whole. If you would like to have access to the results, please contact me at (352) 246-9578 or hicksee@vcu.edu. The results will be sent to you at the end of this study.

Thank you for your consideration.

Sincerely,

Eric Hicks, MS OTR/L
1449 Wilshire Circle
Hopkinsville, KY 42240
(352) 246-9578
hicksee@vcu.edu

Tony Gentry, Ph.D, OTR/L, FAOTA
Associate Professor
Department of Occupational Therapy
College of Health Professions
Box 980233
Richmond, VA 23298-0008
Phone: (804) 828-2219

Appendix 5: Recruitment Sources

Source	Frequency
Email	
Individuals	7
Agencies/Clinics/Associations	41
State Vocational Rehabilitation Agencies	50
LinkedIn Connections	48
LinkedIn Groups*	
American Academy of Optometry	14,099
Low Vision	4,291
Optometry Network	5,432
Optometry Professionals Network	10,986
Optometric Glaucoma Society	100
Vision Rehabilitation Specialists	16
The Low Vision Network	2,240
Medical Device Ophthalmology Optometry	14,346
Facebook Friends	20
Facebook Groups*	
Blind and Vision Impaired Support Network	9,793
Low Vision	4,281
Low Vision Support Group	668
Total	66,418

Note: *Numbers for groups represent the number of members in the group.

Appendix 6: General/Social Media Announcement Recruitment Letter

<u>Social Media/General Announcement</u>

My name is Eric Hicks and I am a graduate student at Virginia Commonwealth University. I am inviting people with vision impairments as well as professionals who provide services to people with vision impairments to participate in my survey. I am studying their potential use of technology, like Skype and Facetime, to enhance in-person services they receive or provide.

Your participation in this survey is voluntary. If you choose to be in this study, I will need you to respond to an ANONYMOUS ONLINE SURVEY that will require between 15 - 20 minutes of your time. The survey link is:

https://bit.ly/3d21R4m

Please feel free to share this link with any of the following people:

- People with vision impairments
- Ophthalmologists
- Optometrists
- Low vision therapists
- Rehabilitation counselors
- Orientation and mobility specialists
- Occupational therapists
- Vision rehabilitation therapists

The survey will be available for three weeks. If you have any questions or concerns, please don't hesitate to contact Eric Hicks, MS OTR/L by email (hicksee@mymail.vcu.edu) or phone at (352) 246-9578.

Your time and effort to complete this survey is greatly appreciated!

Eric Hicks, MS OTR/L

Doctoral Candidate

Virginia Commonwealth University

College of Health Professions

Ph.D Program in Health Related Sciences

Appendix 7: Social Media Biographical Statements

Facebook

My name is Eric Hicks I am a doctoral student in VCU's PhD Program in Health Related Sciences.

LinkedIn

Hello! My name is Eric Hicks and I have been an occupational therapist for almost 20 years. Currently, I am a doctoral student in Virginia Commonwealth University's Ph.D Program in Health Related Sciences Occupational Therapy Specialty Track. My areas of concentration are low vision rehabilitation and telerehabilitation. For my doctoral dissertation, I am conducting a study entitled "Intentions to Use Telerehabilitation for Communication and Treatment for Vision Impairments."

Instagram

I am a doctoral student in VCU's Ph.D Program in Health Related Sciences OT Specialty Track.

Appendix 8: VCU IRB Approval Letter

VCU

Eric Hicks <hicksee@mymail.vcu.edu>

Notification: IRB HM20013559 Gentry - IRB Correspondence

1 message

IRBPANELA@vcu.edu <IRBPANELA@vcu.edu> Tue, Dec 15, 2020 at 9:44 AM
Reply-To: IRBPANELA@vcu.edu
To: hicksee@vcu.edu

VCU Office of Research and Innovation

Office of Research and Innovation
Office of Research Subjects Protection
BioTechnology Research Park
800 East Leigh Street, Suite 3000
Box 980568
Richmond, Virginia 23298-0568

(804) 828-0868
Fax: (804) 827-1448

TO: Lynwood Gentry
Lynwood Gentry
CC: Eric Hicks

FROM: VCU IRB Panel A

RE: Lynwood Gentry ; IRB HM20013559 Intentions to Use Telerehabilitation for Communication and Treatment for Vision Impairments

On 12/15/2020 the referenced research study *qualified for exemption* and was *approved by limited IRB review* according to 45 CFR 46 by VCU IRB Panel A under exempt category/categories

Category 2(iii) Research that only includes interactions involving educational tests, survey or interview procedures, or observation of public behavior when Identifiable information is recorded by the investigator, and the IRB conducted a limited IRB review

Note that the research team is expected to follow the recruitment methods outlined in Question 4 of the "Procedures" Smart Form and using the submitted recruitment materials. If any changes, amendments, or additions need to be made to these procedures or materials, an amendment will need to be submitted to reflect these new methods.

The information found in the electronic version of this study's smart form and uploaded documents now represents the currently approved study, documents, and HIPAA pathway (if applicable). You may access this information by clicking the Study Number above.

COVID-19 Notice

In the context of the COVID-19 pandemic, the IRB expects the research will proceed in accordance with other institutional policies and as outlined in this submission and if applicable, in the study's COVID-19 Contingency Protocol. IRB approval does not necessarily mean that your research may proceed. For more information on investigator responsibilities and institutional requirements, please see https://research.vcu.edu/covid-19.htm

The Principal Investigator is also reminded of their responsibility to ensure that there are adequate resources to carry out the research safely. This includes, but is not limited to, sufficient investigator time, appropriately qualified research team members, equipment, and space. See WPP#: IX-1 Principal Investigator Eligibility and Statement of Responsibilities

If you have any questions, please contact the Office of Research Subjects Protection (ORSP) or the IRB reviewer(s) assigned to this study.

The reviewer(s) assigned to your study will be listed in the History tab and on the study workspace. Click on their name to see their contact information.

Attachment – Conditions of Approval for Exempt Studies

Conditions of Approval for Exempt Studies (version 1/21/2019)

In order to comply with federal regulations and the terms of this approval, the investigator must (*as applicable*):

1. Conduct the research as described in and required by the IRB-approved protocol/smartform.
2. Confirm that all non-VCU sites that have been approved to rely on the VCU IRB for research requiring limited IRB review [45 CFR 46.104(d)(2)(iii), (d)(3)(i)(C), (d)(7), or (d)(8)] are aware of and agree to abide by the reliance relationship and the institutional responsibilities outlined in WPP XVII-6.
3. Submit amendments to the VCU IRB for review and approval before the following types of changes are instituted at any site under the VCU IRB's oversight (VCU sites and non-VCU sites that rely on the VCU IRB):
    - Change in Principal Investigator
    - New source of funding
    - Addition or removal of non-VCU sites whenever one or more of the following applies:
        - VCU is the lead site in a multicenter study,
        - A VCU investigator is overseeing study conduct and/or directly conducting research at another site, and/or
        - De-identified or identifiable research data will be sent to a different site
    - Any change that poses new risks or increases the risks to participants including, but not limited to, the following types of changes:
        - Changes in the study's measures or the research intervention, including
            - Changes in behavioral intervention procedures or the use of deception,
            - Changes related to sexual activity, abuse, past or present illicit drug use, illegal activities, other sensitive topics, or other factors that might place participants at risk of civil or criminal liability
            - Changes reasonably expected to provoke psychological distress or that could make participants vulnerable, or
            - Changes that relate to participants' financial standing, employability, educational advancement, or reputation.
        - Changes in the source of secondary information or biospecimens
        - Changes in the confidentiality or privacy protections used by the study, including
            - Changes in the storage location or method of storage of research materials
            - Changes in the identifiers being used to carry out secondary research (regardless of whether identifiers are retained in the research data).
            - Changes related to the sharing of individual-level research data
        - Changes in recruitment strategy
        - Changes in the planned compensation to participants
    - Changes that alter the category of exemption or that add additional exemption categories
        - Changes that add procedures or activities not covered by the exempt category(ies) under which the study was originally determined to be exempt
        - Changes in the planned participant population (e.g. addition of children, wards of the state, or prisoner participants, students, control groups, etc.)
        - Changes in the participant identifiers being used and/or collected
        - For studies currently approved under Pre-2018 Common Rule Exempt Category 4: Change in inclusion dates for retrospective record reviews if the new date is after the original approval date for the exempt study. (Example: The approval date for the study is 9/24/18 and the original inclusion dates were 01/01/08-06/30/18. This could be changed to 01/01/06 to 09/24/18 but not to end on 09/25/18 or later.)

        Changes that do not meet these criteria do not have to be submitted to the IRB. If there is a question about whether a change must be sent to the IRB please call the ORSP for clarification.

4. Provide non-English speaking participants with a written translation of the approved consent information in language understandable to the research participant. The IRB must approve the translated version prior to use.
5. Monitor all problems (anticipated and unanticipated) associated with risk to research participants or others.
6. Report Unanticipated Problems (UPs), following the VCU IRB requirements and timelines detailed in WPP VII-6
7. Respond promptly to all inquiries by the VCU IRB and Office of Research Subjects Protection concerning the conduct of the research.

The VCU IRB operates under the regulatory authorities as described within:

- *U.S. Department of Health and Human Services Title 45 CFR 46, Subparts A, B, C, and D and related guidance documents.*
- *U.S. Food and Drug Administration Chapter I of Title 21 CFR 50 and 56 (for FDA regulated research only) and related guidance documents.*

- *Commonwealth of Virginia Code of Virginia 32.1 Chapter 5.1 Human Research (for all research).*

IRB PERFORMANCE SURVEY:
We value your feedback! Please take 1-2 minutes to complete the IRB Performance Survey in relation to your experience with this approved submission: https://IRBperformancesurvey.questionpro.com

Vita

Eric Eugene Hicks was born on August 16, 1976, in Stuttgart, Germany. He graduated from George P. Butler Comprehensive High School, Augusta, Georgia in 1994. He received his combined Bachelor of Science in Health Sciences and a Master of Science in Occupational Therapy from Touro College School of Health Sciences, Bay Shore, NY in 2000. Along with his combined Bachelor of Science/Master of Science degree he also earned an Internal Specialization Certificate in Geriatrics. As an occupational therapist, he had the opportunity to work in a variety of clinical settings, including skilled nursing facilities, home health, early intervention, school-based therapy, and low vision rehabilitation. While living in Gainesville, FL he opened a private low vision rehabilitation practice where he contracted services with the Florida Division of Blind Services. In 2010, he transitioned to academia as the Founding Director of the OTA Program at Concorde Career College in Memphis, TN. Since 2010, he has served as the program director for several occupational therapy assistant programs. Currently, he is the Director of the Occupational Therapy Assistant Program at Ross College in Hopkinsville, KY.