Spring 2019

Examining the Relationship Between Expectancy-Value Motivation, Barriers, and Physical Activity Engagement Among Adults with Visual Impairments

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EXAMINING THE RELATIONSHIP BETWEEN EXPECTANCY-VALUE MOTIVATION, BARRIERS, AND PHYSICAL ACTIVITY ENGAGEMENT AMONG ADULTS WITH VISUAL IMPAIRMENTS

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A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

EDUCATION

OLD DOMINION UNIVERSITY
May 2019

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ABSTRACT

EXAMINING THE RELATIONSHIP BETWEEN EXPECTANCY-VALUE MOTIVATION, BARRIERS, AND PHYSICAL ACTIVITY ENGAGEMENT AMONG ADULTS WITH VISUAL IMPAIRMENTS

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Despite the documented benefits associated with physical activity, adults with visual impairments tend to participate in insufficient physical activity for health promotion. Current literature suggests that barriers to physical activity, or factors that constrain participation in physical activity, may inform the physical activity participation of adults with visual impairments. The purpose of the first study was to develop and validate a brief scale designed to measure the magnitude of barriers to physical activity for use among adults with visual impairments. Expectancy-value theory may offer insight into physical activity by examining adults with visual impairments' expectancy beliefs and subjective task values surrounding physical activity. The purpose of the second study was to examine the relationship between barriers to physical activity, expectancy-value variables, and physical activity engagement among adults with visual impairments. The Barriers to Physical Activity for Adults with Visual Impairments scale (BPAAVI) was developed in four phases: (a) item development, (b) content validity, (c) exploratory factor analysis, and (d) confirmatory factor analysis. The factor analyses yielded 12 items across three underlying factors (i.e., accessibility barriers, personal barriers, and transportation barriers). The BPAAVI was found to be a valid and reliable measure of barriers to physical activity for adults with visual impairments. Participants in the second study completed the BPAAVI, the Self- and Task-Perception Questionnaire, the International Physical Activity

Questionnaire-Short Form, and a demographic questionnaire. Associations between variables were explored via correlation and regression analyses. Positive relationships were found between expectancy-value variables and physical activity engagement, while barriers to physical activity and physical activity engagement were negatively correlated. A significant amount of variance (20.30%) in physical activity engagement was explained by the model. Intrinsic or interest value and expectancy beliefs each emerged as significant predictors of physical activity engagement, which suggests that expectancy-value theory may have some utility for investigating the physical activity engagement of individuals with visual impairments.

To those who participated in these studies. You will probably never read this document (it’s a bit wordy), but this work truly for and because of you. Thank you.

ACKNOWLEDGEMENTS

The completion of this project, and indeed my doctoral education altogether, would not have been possible without the support of numerous individuals in my professional and personal life. These few words are not enough to express my gratitude, but they I hope they will suffice.

First, I would like to express my sincere appreciation to my graduate advisor, Dr. Justin Haegele. Without your guidance and seemingly boundless patience, I could not have made it through my doctoral studies. Thank you for taking a chance on this (even later than) last-minute applicant and demanding excellence from me along the way. I'm continually impressed by your work ethic, and if I manage to be half as productive in my own right, I know I'll be doing okay.

I must also extend sincere thanks to the members of my dissertation committee, Drs. Xihe Zhu and Jonna Bobzien. Dr. Zhu, thank you for your supervision throughout the methodological formulation of my dissertation, particularly for your guidance regarding data analyses. Dr. Bobzien, thank you for your attention to detail in the editing process, and for your kind words of encouragement. Beyond my committee members, I would also like to acknowledge the chair of the department of Human Movement Sciences, Dr. Lynn Ridinger, thank you for your ongoing support of my travel to conferences and professional events that have contributed to my development as a researcher.

Outside of ODU, I would like to acknowledge my past mentors Drs. Martin Block and Luke Kelly at the University of Virginia, who were instrumental in building my adapted physical activity content expertise. Special thanks to Dr. Diane Whaley, for introducing me to motivational psychology and for being the first person to tell me I that I had what it takes to further my education at the doctoral level, and for trying in vain to help me understand the work that lay ahead of me.

To Sumner, Amanda, and Bex, I appreciate our teamwork, encouragement, commiseration, inside jokes, taco nights, and pickle parties. Not all graduate cohorts form bonds as strong as we have over the last three years. Thanks for the friendships we've built and the Air BnBs we've shared. I can't wait to see what each of you does next.

Finally, to my family near and far, I extend my appreciation. To my dad, thank you for believing in me, reading everything I've gotten published, and moving my furniture across the country without complaint. It will be honor to become the doctor (sort of) that you can tell your friends about. Most of all, thank you to Rosie. Unfortunately, I have neither the space nor the capacity to express the depth of my gratitude, but I thank you for your unwavering faith in me and every sacrifice you've made for us both along the way. Thank you for giving me my chance. It's your turn now, I will try my best to return the favor.

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CHAPTER I: INTRODUCTION

Physical activity has been linked to disease prevention and improved mental and physical health (Centers for Disease Control and Prevention [CDC], 2014; Warburton, Nicol, & Bredin, 2006). Documented benefits of regular engagement in physical activity include decreased chances of developing cardiovascular disease, hypertension, diabetes, stroke, osteoporosis, obesity, depression, and some cancers (CDC, 2014; Warburton et al., 2006). Despite this, reports indicate that less than half of all adults in North America participate in the amount of weekly physical activity that has been recommended by the World Health Organization (WHO, 2010; Colley et al., 2011). Among adult populations with disabilities, population-based self-report studies have found that between 20-35% of American adults with disabilities engage in sufficient physical activity, as compared with 35-53% of American adults without disabilities (Altman & Bernstein, 2008; Carroll et al., 2014).

Physical Activity & Visual Impairment

Though several studies have investigated the physical activity practices of adults with visual impairments, results concerning the average physical activity levels of this population have been inconclusive. Several studies have found that the majority of adults with visual impairments do not typically meet physical activity guidelines (Carroll et al., 2014; Holbrook, Caputo, Perry, Fuller, & Morgan, 2009; Holbrook, Kang, & Morgan, 2013; Marmeleira, Laranjo, Marques, & Pereira, 2014; Starkoff, Lenz, Lieberman, Foley, & Too, 2017). Conflictingly, however, other studies have found that those with visual impairments may engage in an adequate amounts of physical activity (Barbosa Porcellis da Silva, Marques, & Reichert, 2017; Labudzki & Tasiemski, 2013). While these results are promising, in each report, the authors themselves note that the populations that made up their samples may not have provided a true representation of the population of adults with visual impairments at large. For example, Barbosa Porcellis da Silva and colleagues (2017) recruited the majority of their sample from a recreation facility for adults with visual impairments, which could account for the higher level of physical activity presented in the results. Labudzki and Tasiemski (2013) utilized a population that consisted primarily of highly-educated urban dwellers, which may also have impacted generalizability of their findings.

In addition to investigating the physical activity levels of adults with visual impairments, several inquiries have attempted to better understand variables that are related to physical activity engagement. Socio-demographic variables such as age, gender, racial or ethnic background, and visual impairment level have been well-researched, although the results are not definitive (Barbosa Porcellis da Silva et al., 2017; Haegele, Zhu, Lee, & Lieberman, 2016; Holbrook et al., 2009; Starkoff et al., 2017). For example, several studies have found differences in the intensity of overall engagement in physical activity across visual impairment levels (Barbosa Porcellis da Silva et al., 2017; Starkoff et al., 2017). Still other studies found gender differences in physical activity engagement among adults with visual impairments wherein maleness was associated with significantly higher physical activity levels (Haegele et al., 2016; Starkoff et al., 2017).

In addition to socio-demographic variables, barriers, or factors that inhibit physical activity participation, have been the subject of some attention within the context of visual impairment research. Examples of barrier types include environmental, personal, or social barriers to physical activity (Jaarsma, Dekker, Koopmans, Dijkstra, & Geertzen, 2014; Lee, Zhu, Ackley-Holbrook, Brower, & McMurray, 2014; Shaw, Flack, Smale, & Gold, 2012). Commonly experienced environmental barriers include transportation and lack of accessible options in the neighborhood (Jaarsma, Dekker, Koopmans, Dijkstra, & Geertzen, 2014). Frequently reported personal and social barriers to physical activity include being dependent on others to be active, lack of motivation to be active, and having a visual impairment (Jaarsma et al., 2014; Lee et al., 2014). One study that compared barriers reported by participants across visual impairment levels concluded that individuals with some usable vision were generally less impacted by barriers than were those with minimal to no light perception (Shaw et al., 2012).

Scholars in the field of adapted physical activity have long advocated for the use of psychological theories to better understand the underlying reasons that individuals with various types of disabilities, including visual impairment, are active or inactive (Cervantes & Taylor, 2011; Crocker, 1993; Reid & Stanish, 2003). To that end, motivational factors associated with physical activity engagement among adults with visual impairments have also been the subject of some investigation. For example, one study by Haegele, Hodge, and Kozub (2017) utilized the theory of planned behavior, a belief-to-behavior model of understanding motivation, to examine the relationship between intentions to be physically active and physical activity engagement among adults with visual impairments. In addition to theory of planned behavior, some studies have used social cognitive theory to examine the relationship between motivation and physical activity (Haegele, Brian, & Lieberman, 2017; Haegele, Kirk, & Zhu, 2018). Haegele, Brian et al. (2017) found that social supports were positively associated with physical activity engagement among a sample of adults with visual impairments and Haegele et al. (2018) found that adults with visual impairments who reported higher self-efficacy were more likely to report being more physically active than those who were not as self-efficacious. Though these findings have provided some information about the relationship between motivational beliefs and physical activity amongst this population, additional investigation into this phenomenon from a theory-based perspective is needed. One theoretical model that could add to the growing body of knowledge in motivation and physical activity among adults with visual impairments is expectancy-value theory.

Theoretical Framework

In addition to the models that are already in use within the field of adapted physical activity and visual impairment research, the expectancy-value theory of motivation could prove useful for improving the understanding of motivational factors that influence physical activity. Expectancy-value theory was developed in the field of educational psychology beginning in 1983, and has been continually employed across different motivational contexts since then (Eccles et al., 1983; Eccles & Wigfield, 2002; Wigfield & Cambria, 2010; Wigfield & Eccles, 2000). In essence, expectancy-value theory posits that the more one values a behavior and believes that they was successful at it, the more likely they are to choose to engage in it (Eccles et al., 1983). To investigate these relationships, Eccles and colleagues (1983) defined and developed two constructs that act as direct influencers on a behavior, as well as a host of constructs that have an indirect impact on behavior.

The first construct that is said to be directly related to behavior is termed expectancy beliefs (Eccles et al., 1983). Expectancy beliefs are a unidimensional construct that refer to both how well one believes that they will do when performing a specific behavior, as well as how competent one believes they are at the activity itself (Eccles et al., 1983; Wigfield & Eccles, 2000). Per the model, the second construct that has a direct impact on the behavior is that of subjective task values, or the qualities one associates with a behavior or task that give it importance (Eccles et al., 1983). Unlike expectancy beliefs, subjective task values are multi-dimensional and include (a) attainment value, (b) intrinsic or interest value, and (c) utility value.

Each type of value is intended to capture a unique type of importance a behavior or task may hold for an individual (Eccles et al., 1983; Eccles & Wigfield, 2002). Attainment value relates to the importance one ascribes to doing well at a task and how such an achievement supports the individual's feelings about the type of person they are (Eccles et al., 1983; Wigfield & Eccles, 2000). Intrinsic or interest value is defined as the enjoyment associated with engaging in a task or behavior, as well as the general interest one has in participating in it (Eccles et al., 1983; Wigfield & Eccles, 2000). Utility value refers to the perceived usefulness of a task or activity, particularly with regard to an individual's near or long-term goals (Eccles et al., 1983). In addition to the three types of values, the model defines a fourth dimension of subjective task values, which is termed cost (Eccles et al., 1983). In contrast with the three values, cost may be understood to be the perceived drawbacks of undertaking a task or behavior (Eccles et al., 1983; Wigfield & Eccles, 2000). Costs may be financial, temporal, physical, or emotional in nature and may only detract from the overall value of a task (Eccles et al., 1983; Eccles & Harold, 1991).

Statement of the Problem

The role of physical activity in health promotion and disease prevention is well-understood (CDC, 2014; Warburton, Nicol, & Bredin, 2006). Despite this, research has not consistently demonstrated that adults with visual impairments engage in sufficient physical activity (Carroll et al., 2014; Holbrook et al., 2009; Holbrook et al., 2013; Marmeleira et al., 2014; Starkoff et al., 2017). Environmental, social, and personal barriers to physical activity may be related to the physical activity patterns of adults with visual impairments (Lee et al., 2014; Shaw et al., 2012). Little is known, however, about the relationship between expectancy-value beliefs and physical activity engagement among adults with visual impairments. The current studies aimed to further examine the relationships between barriers, expectancy-value beliefs, and physical activity engagement among adults with visual impairments.

Purpose of the Studies

The author has adopted a multiple-article format for this dissertation. As such, each study has a purpose and research design. The purpose of the first study was to develop and validate a brief scale designed to measure the magnitude of barriers to physical activity for use among adults with visual impairments. The purpose of the second study was to examine the relationship between barriers to physical activity, expectancy-value variables, and physical activity engagement among adults with visual impairments

Research Questions

1. Is the newly-developed Barriers to Physical Activity for Adults with Visual Impairment (BPAAVI) scale a valid and reliable measure of perceived barriers to physical activity experienced by adults with visual impairments?
2. To what degree are barriers to physical activity related to the physical activity levels of adults with visual impairments?
3. To what degree are expectancy-value beliefs related to physical activity levels of adults with visual impairments?
4. To what degree are barriers to physical activity related to expectancy-value beliefs?

Significance of the Studies

The first study further developed the knowledge base concerning the types and magnitude of barriers perceived by adults with visual impairments. Using the instrument developed and validated by this research, scholars can continue to investigate the role of barriers on adults with visual impairments across different geographical locations and socio-demographic groups using the instrument constructed herein. The second study expanded researchers' understandings of the role of motivational beliefs in the physical activity practices of adults with disabilities by being, to the author's knowledge, the first quantitative study to utilize the expectancy-value model within this context. Results from this study may be used to develop targeted interventions to influence expectancy-value beliefs about physical activity among adults with visual impairments.

Delimitations

The following are delimitations to this study:

1. Criteria for inclusion was purposefully limited to include only adults with self-reported visual impairments between the ages of 18 and 66 years old at the time of data collection.
2. Because the instruments used in the studies were written in the English language, only participants who were fluent in the English language were able to participate.
3. Online registries and social media platforms were used to recruit participants. This may have limited the sample to those who were active on social media or subscribed to online registries.
4. Participants were asked to recall their physical activity for the prior week only, which may not reflect the overall physical activity levels of all participants.

Limitations

This study presented the following limitations:

1. The use of a non-interventional, correlational design did not allow for the formation of causal relationships and did not completely mitigate the potential for confounding variables.
2. The use of a cross-sectional design explored participants' beliefs and physical activity engagement for that moment in time and did not reflect any change in behavior or beliefs over time.

3. The exclusion of youth (aged 17 or younger) and older adults (aged 66 or older at the time of data collection) limited the generalizability of findings to populations other than adults with visual impairments ages 18-65 years.
4. The exclusion of non-English speakers may have limited the generalizability of findings to populations of adults with visual impairments in other cultural or geographical settings.

Definition of Terms

Physical activity. Physical activity is defined as any bodily movement that results in energy expenditure (Casperson, Powell, & Christenson, 1985).

Visual impairment. The CDC defines the legal criteria for blindness as having a visual acuity of less than 20/200 or a visual field of less than 20 degrees in the better eye with the best possible correction, and visual impairment as having visual acuity of less than 20/40 in the better eye with correction (CDC, 2017). To further investigate potential differences between individuals with different levels of visual impairment, the studies contained herein used the classification system devised by the United States Association of Blind Athletes (United States Association of Blind Athletes [USABA], 2013). The USABA classification system contains four categories of visual impairment (B1-B4). Individuals that meet the criteria for B1 are those who range from having no vision in either eye to those who have some light perception, but are not able to recognize the shape of a hand from any distance or direction using their better eye. A B2 classification refers to those who are able to recognize the shape of a hand in their better eye to those who have a visual acuity of up to 20/600 or a visual field of 5 degrees or less in their better eye with best possible correction. B3 classification ranges from 20/600 to 20/200 or a visual field of greater than 5 degrees but less than 20 degrees in the better eye with the best correction. Individuals who are classified as B4 are typically said to have "low vision" and do not meet the criteria for legal blindness, although they are still considered to have a visual impairment under the definition provided by the CDC.

Barriers. Barriers are defined by Lee and colleagues (2014) as conditions that have a negative influence on a behavior, in this case, physical activity.

Expectancy beliefs. The degree to which an individual believes that they are likely to be successful when engaging in a specified task or behavior (Eccles et al., 1983).

Subjective task values. The overall importance a task or behavior holds for an individual.

Attainment value. The importance being successful at a task or behavior holds for an individual's sense of self or identity (Eccles et al., 1983).

Intrinsic or interest value. The enjoyment one derives from participating in a task or behavior (Eccles et al., 1983).

Utility value. The usefulness or relevance that a task holds for an individual (Eccles et al., 1983).

Cost. The perceived drawbacks associated with engaging in a task or behavior (Eccles et al., 1983).

CHAPTER II: REVIEW OF LITERATURE

The purpose of this chapter is to review current literature that is relevant to this inquiry and to introduce the conceptual framework in which it is situated. First, the chapter summarizes the importance of physical activity for health promotion and provides a summary of research related to the physical activity engagement of the general population. Next, research related to physical activity within disability populations is reviewed. Then literature on physical activity within the context of adults with visual impairments is reviewed. Expectancy-value theory of motivation is presented and its application to physical activity is examined.

Importance of Physical Activity

The impact of physical activity engagement on overall health has been well-researched (Blair & Morris, 2009; Centers for Disease Control and Prevention [CDC], 2014; Penedo & Dahn, 2005; Warburton, Nicol, & Bredin, 2006). Benefits of regular physical activity for adults include decreased risk of cardiovascular disease, hypertension, diabetes, stroke, osteoporosis, obesity, depression, and some cancers (CDC, 2014; Penedo & Dahn, 2005; Warburton et al., 2006). The United States Department of Health and Human Services (USDHHS; 2008) recommends that healthy adults between the ages of 18 and 65 engage in at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity each week. For additional health benefits, it is suggested that healthy adults include muscle strengthening exercise at least twice per week and increase their moderate-intensity physical activity to at least 300 minutes each week to improve personal fitness associated with dose-response (Haskell et al., 2007; USDHHS, 2008). Despite this, research indicates that less than half of North American adults meet the minimums prescribed by these guidelines (CDC, 2007; Colley et al., 2011; Troiano et al., 2007; Tucker, Welk, & Beyler, 2011). Further, studies that compared indirect measures of physical activity (e.g., self-report) to direct measures such as accelerometers found that even though most people did not self-report meeting physical activity guidelines, they still generally overestimated their engagement by a considerable margin (Troiano et al., 2007; Tucker et al., 2011). For example, Tucker et al. (2011) found that while 62% of adults met or exceeded physical activity guidelines as measured by self-report, only 9.6% met the standard when measured directly via accelerometer. The authors posit several potential reasons for this discrepancy, including misinterpreting perceived exertion for true physical activity levels when self-reporting and overestimating physical activity engagement in order to seem more socially acceptable (Tucker et al., 2011). They also consider the prospect that while accelerometers are more objective than recall instruments, there are certain types of physical activity (e.g., upper body movements, swimming, or cycling) that are not captured accurately by hip-mounted accelerometers, and thus activity might have been higher than it appeared. They did note, however, that any missed activity was unlikely to be substantial enough to account for the entire discrepancy between the self-report and direct measures they employed (Tucker et al., 2011).

Correlates of physical activity among adults in the general population have been the subject of a large body of research. In a review of 38 studies, Trost, Owen, Bauman, Sallis and Brown (2002) examined a variety of types factors including demographic, psychological, behavioral, social and cultural, and physical and environmental. In keeping with previous reviews, they found that age, weight status, and gender were consistent demographic correlates, in that age and weight were negatively associated with physical activity engagement, and women averaged less physical activity than did men. Trost and colleagues (2002) also found that race or ethnicity had a consistent relationship with physical activity across multiple studies, and that Persons of Color were generally less active than their White counterparts. Among psychological factors, physical activity self-efficacy (i.e., how confident one is in their ability to be physically active) was positively related to physical activity engagement. Other psychological correlates included perceived barriers to physical activity, including personal, interpersonal, and environmental barriers, which were negatively related to physical activity engagement, especially among older adults. Of the social and cultural factors that were reported, social support was positively associated with physical activity. Satisfaction with local recreational facilities, presence of enjoyable scenery, and urban environments were all environmental factors that were positively related to physical activity engagement (Trost et al., 2002).

Physical Activity & Disability

While physical activity engagement among the general population has been examined at length, the physical activity levels of adults with disabilities has been studied with less frequency. A report using the CDC's *Healthy People 2010* data found that 29.5% of American adults who reported having a disability of any kind engaged in less activity than their peers without disabilities (Altman & Bernstein, 2008). This report concluded that about 20% of American adults with disabilities could be classified as participating in regular physical activity, as compared with 35% of adults with no disabilities (Altman & Berstein, 2008). Altman and Bernstein (2008) also found that inactivity (i.e., reporting no instances of light to moderate physical activity) was much more common among adults with disabilities than among those without (over 40% and 32.8%, respectively). Carroll and colleagues (2014) analyzed similar self-report data from the 2009-2012 National Health Interview Survey to investigate physical activity levels and other health factors of adults with disabilities and found that approximately 31% of adults with disabilities reported participating in adequate physical activity, as compared with 53.7% of those who did not have a disability. Again, adults with disabilities were more likely to report being inactive than were those without disabilities (47.1% and 26.1%, respectively; Carrol et al., 2014). While reports using direct measures (e.g., accelerometers) of the physical activity levels of adults without disabilities has been somewhat well-documented, to the author's knowledge, there are no large-scale reports of this nature that concern adults with different types of disabilities. So, while objective measures may be considered the most accurate means of collecting such data, self-report measures are more commonly used within this population.

Physical Activity & Visual Impairment

In comparison with empirical research regarding physical activity within the larger population of individuals with disabilities, less research has been conducted within the context of physical activity and visual impairment, particularly among adult populations. While several reviews of literature concerning the physical activity of school-aged children with visual impairments (Augestad & Jiang, 2015; Haegele & Porretta, 2015; Piva da Cunha Furtado, Allums-Featherston, Lieberman, & Gutierrez, 2015), no article has synthesized this information for a similar adult population. This section reviews published findings in this area of inquiry including (a) descriptive studies about physical activity levels, and (b) correlates of physical activity among adults with visual impairment.

Descriptive Research

The body of research concerning the physical activity practices of adults with visual impairment is relatively small. But, in contrast with reports that include multiple disability types, several studies using relatively small samples of adults with visual impairments have utilized direct measures such as accelerometers or pedometers to measure physical activity levels directly. A study of 25 American adults with visual impairments recorded physical activity via pedometers and found that over a seven-day period, participants accumulated an average of 8,028 steps per day (Holbrook, Caputo, Perry, Fuller, & Morgan, 2009). In a similar study of 33 American adults with visual impairments, participants with visual impairments average fewer steps at 5,530 steps per day (Holbrook, Kang, & Morgan, 2013). In both studies, adults with visual impairments did not meet the recommended 10,000 steps per day, nor did they meet the average step count for same-aged peers who are sighted (11,075 steps per day) (Holbrook et al., 2009).

Marmeleira et al., (2014) utilized accelerometers to capture the physical activity patterns of 63 Portuguese adults with visual impairments. Participants wore accelerometers for three days, including one weekend day, and were found to engage in an average of 5,412 steps per day and 168 minutes of physical activity, which was largely composed of light physical activities such as walking (Marmeleira et al., 2014). Less than 30% of participants engaged in more than 30 total minutes of vigorous physical activity three times per week. Those who did amass 30 minutes of vigorous activity did not do so in bouts of at least 10 minutes at a time and were not vigorously active for at least 10 consecutive minutes at a time, as per the physical activity guidelines (Marmeleira et al., 2014). In contrast, a study of 90 Brazilian adults with visual impairments found that 61% of participants met physical activity guidelines (as measured via accelerometer), which is similar to the physical activity levels of Brazilian adults without disabilities (Barbosa Porcellis da Silva, Marques, & Reichert, 2017). However, the authors attribute this unusually high activity in part to their sample, which was drawn mostly from an institution that provides services, including recreation, for adults with visual impairments (Barbosa Porcellis da Silva et al., 2017). This is in contrast with the other studies presented herein.

Several additional studies used self-report to measure the physical activity practices of adults with visual impairments indirectly. The aforementioned report by Carroll et al. (2014) separated visual impairment data from those of other disability populations. Though their physical activity levels were still lower than those of individuals without disabilities, adults with visual impairments had the second highest self-reported physical activity rates of any disability group (behind Deaf/hard of hearing adults) with 40.9% adherence to physical activity standards (Carroll et al., 2014). However, the same report found that 36.4% of adults with visual impairments did not report any physical activity engagement. One smaller study utilizing self-report data for physical activity among those with visual impairments aligned with Carroll and colleagues' (2014) findings. A study of 82 Polish adults with visual impairments that utilized the International Physical Activity Questionnaire (IPAQ) found that 51.8% reported being highly active while just 20.7% reported being inactive (Labudzki & Tasiemski, 2013). A second study conducted among 115 adults with visual impairments in the United States using self-report data from the IPAQ found that 21.7% of participants reported meeting the physical activity guidelines, a considerably smaller amount than was reported in the previous findings (Starkoff, Lenz, Lieberman, Foley, & Too, 2017).

Finally, one study aimed to compare data that were collected directly via accelerometer from 25 adults with visual impairments and 25 sighted adults to their self-reported account of physical activity during the same timeframe (Sadowska & Krzepota, 2015). Whether measured via self-report or accelerometer, the study found that participants with visual impairments took fewer steps than their sighted peers, while there were no significant differences in total physical activity. Results of the IPAQ self-report strongly correlated with accelerometer results for individuals with visual impairments, which indicates that adults with visual impairments may be more accurate in recalling their physical activity than their sighted peers (Sadowska & Krzepota, 2015).

Variables that Impact Physical Activity among Individuals with Visual Impairments

Socio-demographic variables. Although investigation of correlates of physical activity among individuals with visual impairments is still emergent, several researchers have contributed research to the field by examining a variety of demographic, environmental, interpersonal, and motivational variables. Holbrook and colleagues' (2009) aforementioned study included analysis of the relationship between demographic variables and physical activity engagement (as measured by pedometer) for their sample of 25 American adults with visual impairments. No significant associations were found between gender or visual impairment level (i.e., low vision, legal blindness, or minimal light perception/total blindness). Body composition, as measured using the body mass index (BMI), was also not related to physical activity engagement, although there was a main effect for gender on body composition status, wherein female participants across all levels of visual impairment status averaged higher BMI scores (i.e., higher estimated body fat) than their male counterparts (Holbrook et al., 2009).

Similarly, Barbosa Porcellis da Silva et al. (2017) found no relationships between accelerometer-measured physical activity levels and gender, racial or ethnic identity, economic, or marital status among the 90 Brazilian participants included in their study. In contrast with Holbrook and colleagues (2009), this study did find an association between visual impairment level and physical activity engagement, as low vision and legal blindness were positively related with light to moderate physical activity, while having minimal light perception was negatively associated with physical activity at those levels. There was no significant difference in vigorous physical activity engagement across visual impairment levels. Two factors, age and minimal light perception/total blindness, were associated with sedentary activities (Barbosa Porcellis da Silva et al., 2017).

Starkoff and associates' (2017) study also found a relationship between visual impairment level and certain types of physical activity, as measured by self-report. Individuals who met the criteria for legal blindness or low vision spent more time in light intensity physical activity (i.e., walking) than did individuals with minimal light perception or total blindness. No differences between visual impairment levels were observed with regard to moderate or vigorous physical activity. A significant main effect for gender (maleness), as well as an interaction between gender and body mass index (BMI) were found with regard to time spent participating in moderate intensity physical activity, and males accumulated significantly more physical activity overall. Interestingly, investigators found a main effect for BMI wherein overweight participants accumulated more vigorous physical activity when compared with those within the normal weight range (Starkoff et al., 2017).

Another recent study of the influence of socio-demographic factors on the physical activity engagement also found a relationship between gender and physical activity (Haegele, Zhu, Lee, & Lieberman, 2016). Researchers utilized the IPAQ to measure the physical activity engagement of 176 adults with visual impairments and results of a multiple regression analysis indicated that gender, in this case maleness, was a significant predictor of physical activity ($\beta = 0.25$, $p < 0.05$). While no other demographic factors significantly predicted physical activity on their own, a regression model including gender, ethnicity, visual impairment level, years of having a visual impairment, use of a mobility aid, and college education status predicted 11.66% of the variance in physical activity engagement. The authors note that while this number is statistically significant, the effect size is relatively small (f^2 = 0.13), which suggests that the practical implications of this finding may be limited (Haegele et al., 2016).

Barriers and facilitators. One set of factors that has received considerable attention within the field of adapted physical activity, particularly focusing on individuals with visual impairments, are barriers and facilitators of physical activity. Sometimes referred to as constraints on or inhibitors of physical activity, barriers are conditions that have a negative influence on a behavior (Lee, Zhu, Ackley-Holbrook, Brower, & McMurray, 2014). There is no consensus on barrier categories, but they are often categorized by source of constraint they present to the individual. For example, environmental barriers could include poor quality sidewalks, living in a neighborhood that is not pedestrian-friendly, or having limited public transportation access. Psychological barriers can include motivational difficulties, time management, or self-regulatory issues. Interpersonal barriers may include difficulty relying on others for help, or unpleasant interactions with others. Visual impairment itself may be considered a barrier to physical activity (Jaarsma, Dekker, Koopmans, Dijkstra, & Geertzen, 2014; Lee et al., 2014; Shaw, Flack, Smale, & Gold, 2012). Though they are less frequently discussed, facilitators (sometimes called enablers) of physical activity are factors that allow for ease of engaging in a behavior (Jaarsma et al., 2014). Accessible walkways and facilities, reliable transportation, and a personal interest in sport or exercise are examples of some facilitators of physical activity.

In a descriptive study of 648 adults living in the Netherlands, Jaarsma and colleagues (2014) sought to understand barriers and facilitators of physical activity for active and inactive individuals with visual impairments. The authors collected information via online or telephone questionnaire, including items about sport and physical activity participation. Participants were assigned to the active or inactive groups based on their self-reported participation in sports and physical activity per the criteria established by the research team. Among active adults with visual impairments, the most frequently experienced environmental barriers were transportation (26%) and lack of neighborhood options for physical activity (14%). Inactive participants reported lack of training partners or peers (24%) and cost of participating (23%) most frequently. The most common personal barrier to activity among those who were active was being dependent on others (28%), followed by having a visual impairment (14%). Visual impairment was the most frequently reported barrier for inactive participants (24%). In this study, facilitators of physical activity were reported only for active participants, and the most frequently experienced personal facilitators were concern for personal health (85%), followed by fun (75%), and social contacts (50%). Support from family was the most consistently reported environmental facilitator (31%). A logistic regression of all of barriers, facilitators and demographic variables concluded that education level, and use of assistive technologies were positive predictors of sports and physical activity participation, while having a visual impairment, cost, and lack of training partners negatively predicted participation (Jaarsma et al., 2014).

Two studies investigated types of barriers as well as strategies for overcoming them among adults with visual impairments (Kirchner, Gerber, & Smith, 2008; Shaw et al., 2012). In a study of environmental barriers to community-based physical activity among 134 adults with various disabilities who utilized mobility aids including long canes and guide dogs associated with visual impairment, problems with sidewalks or pavement and poor drainage or puddles were the most commonly reported barriers across all groups. Problems with sidewalk or pavement were considered important barriers by 94% of individuals with guide dogs and 88% of long cane users, while puddles or poor drainage were barriers expressed by both those who used guide dogs (91%) and those who use long canes to navigate (78%). Barriers that were less impactful for those groups included problems with hills, too few people around, and lack of stop signs. All groups reported using similar strategies to combat these barriers, including planning routes in advance, altering planned routes, going more slowly than they had intended, or postponing their outing for a different time (Kirchner et al., 2008). Shaw and colleagues (2012) conducted similar research among 204 young adults with visual impairments living in Canada. In this study, participants were asked to rate their agreement with statements about environmental, psychological, and personal constraints using a Likert-type scale. A similar scale was used to examine negotiation strategies. Structural (environmental) constraints emerged as the most inhibitive to physical activity, followed by sight-specific constraints. Constraints that involved interpersonal relationships were least impactful. Individuals with some usable vision (i.e., low vision or legal blindness) found constraints to be less inhibitive than did those with minimal light perception or total blindness, and female participants reported greater impact from structural and intrapersonal factors (i.e., motivational factors, knowledge about physical activity) than did males. The most meaningful negotiation strategies employed by all groups included improving one's financial circumstances, improving interpersonal relationships, and adopting different time management strategies to allow for physical activity engagement. Participants with some usable vision employed more negotiation strategies than those with light perception or less, and female participants reported using more negotiation strategies than did males (Shaw et al., 2012).

While instruments for investigating barriers and facilitators among members of the general population are often used among visual impairment populations, Lee et al. (2014) recognized the potential issues surrounding the validity of such measures and devised the

Physical Activity Barrier Scale for Persons Who are Blind or Visually Impaired. The authors used existing scales for individuals with disabilities and results of a literature review of issues pertaining to physical activity for those with visual impairments to guide instrument construction. To establish content validity, focus group discussions were used to confirm or exclude potential items. The resulting 56-item scale was administered to a sample of 160 adults with visual impairments. Confirmatory factor and Rasch analyses were undertaken to examine construct validity, and following this process, the scale was reduced to 48 items. Barriers were analyzed individually and in categories (e.g., environmental barriers). Results indicated that the largest individual barriers to physical activity participation were lack of discipline, lack of motivation, lack of transportation, not knowing how to use equipment, and lack of access to equipment or facilities. By category, environmental barriers were most impactful on physical activity, followed by psychological factors and knowledge of physical activity itself. Interestingly, of all barrier categories, safety was ranked the least inhibitive (Lee et al., 2014).

Factors situated in motivational theories. Scholars working in the field of adapted physical activity have long called for an increased use of theoretical or conceptual works to ground research and enhance the richness of findings (Cervantes & Taylor, 2011; Crocker, 1993; Reid & Stanish, 2003). Crocker (1993) asserted that adopting theories commonly used by related fields such as exercise or sport psychology would benefit adapted physical activity research by addressing the beliefs of individuals with disabilities about physical activity, which he contended would form a logical basis to develop physical activity interventions for disability populations. Despite the call for such frameworks, the majority of the body of research surrounding physical activity and adults with visual impairment remains atheoretical. However, a small body of work utilizing motivational theories to further investigate the complex relationship that this population has with physical activity engagement has begun to develop.

Haegele, Hodge et al. (2017) utilized the theory of planned behavior to understand the relationships between beliefs about physical activity, intentions to be physically active, and physical activity levels in a study of 209 adults with visual impairments. Developed by Icek Ajzen, the theory of planned behavior is a belief to behavior model that holds that a volitional behavior is directly influenced by the strength of an individual's intention to engage in said behavior (Ajzen, 1985). In turn, intention is shaped by three belief factors including one's attitude toward the behavior (attitude), the amount of control one perceives they have over their ability to be successful in a behavior (perceived behavioral control), and the social support or lack thereof one perceives related to behavioral engagement (subjective norms) (Ajzen, 1985). This model has been applied to many volitional behaviors including achievement in school and career settings, and health settings such as physical activity. Haegele, Hodge, and colleagues developed and validated an instrument specifically for use with adults with visual impairments within the context of physical activity. They found that in keeping with the model, intention to be physically active was a significant predictor of physical activity engagement, regardless of visual impairment level, gender, or other demographic factors ($\beta = .30$, $p < .01$).

In addition to the theory of planned behavior, social cognitive theory has also been employed to explore the relationships between motivational beliefs and physical activity among adults with visual impairments. Developed by Albert Bandura beginning in 1977, social cognitive theory is a large motivational model that centers around motivation and learning. As such, the model includes many factors, but the main constructs that have been applied to research in this context are self-regulation, social support, and self-efficacy (Haegele, Brian, &

Lieberman, 2017; Haegele, Kirk, & Zhu, 2018). While the features of self-regulation vary somewhat across learning theories, it generally pertains to an individual's ability to direct their behaviors toward a desired outcome (Bandura, 1977). Social support is the degree to which one feels supported or not supported when engaging in a behavior. Sources of social support include salient persons (e.g., peers, significant others) and larger groups to which an individual may claim membership (e.g., visual impairment community, African American community). Social cognitive theory states that if one is highly self-regulated and perceives adequate social support, they are more likely to engage in a behavior (Bandura, 1977). To examine these relationships, 92 adults with visual impairments completed a questionnaire about demographic information, self-regulatory behaviors, and perceived social support, and self-reported their physical activity behaviors using the IPAQ (Haegele, Brian et al., 2017). Results of a hierarchical multiple regression analysis indicated that visual impairment level (i.e., having more usable vision) and perceived social support predicted physical activity engagement ($\beta = .31$; $t(86) = 3.32$; $p < .001$ and $\beta = .22$; $t(86) = 2.12$; $p = .037$, respectively). While self-regulation and gender (maleness) were not related to physical activity, they did predict sedentary time when taken along with visual impairment level, as measured by hierarchical multiple regression (($F(3, 88) = 2.68$, $p = .05$; $R^2 = .08$; Adjusted $R^2 = .05$; Haegele, Brian et al., 2017).

Another concept of social cognitive theory, self-efficacy, is a multi-factorial construct described by Bandura (1977) as the strength of one's belief that they was successful when engaging in a specified task or behavior. Per the theory, the more self-efficacious an individual feels toward a task, the more likely they are to engage in it. Using online demographic and self-efficacy questionnaires and the IPAQ, Haegele et al. (2018) applied this concept to 147 participants of adults with visual impairments. A multiple regression analysis including self-efficacy scores and demographic variables (i.e., age, gender, visual impairment level, and income level) explained 10.2% of the variance in physical activity ($F(5, 141) = 3.21$, adjusted r^2 . .093, $p = .009$). Self-efficacy was the only variable that emerged as a statistically positive predictor of physical activity while holding other variables constant ($\beta = .28$, $p = .001$; Haegele et al., 2018).

Expectancy-Value Theory

Though the expectancy-value theory used herein was developed by Eccles and colleagues beginning in the 1983, its roots may be traced to earlier models of motivation, including achievement motivation theory, which was pioneered by psychologist John William Atkinson in the 1950s. Atkinson's (1957) model sought "to explain how the motive to achieve and the motive to avoid failure influence behavior in a situation where performance is evaluated against some standard of excellence" (p. 371). The theory presents one's likelihood to engage in a behavior as a mathematical formula that is the product of motive, expectancy, and incentive toward achieving success measured against the product of motive, expectancy, and incentive toward avoiding failure (Atkinson, 1957). Atkinson (1957) conceived of expectancy as one's anticipation of success or failure following an attempted behavior, and incentive (i.e., value) as the attractiveness of the prospect of success or failure.

Eccles and colleagues (1983) expanded upon earlier definitions set forth by Atkinson (1957) and others through their development of the expectancy-value theory of achievement motivation. Expectancy-value theory aims to explain which behaviors an individual is likely to engage in and why they choose the behaviors they do (Eccles et al., 1983; Wigfield & Cambria, 2010). Expectancy-value theory proposes that behavioral choices are influenced by cultural and interpersonal factors, the perceived positive and negative features of the behavior, and an individual's perceived expectations of success when engaging in the behavior (Eccles et al., 1983; Eccles & Wigfield, 2002). It is important to note that per the model, it is an individual's perception of their relationship to a behavior, rather than objective successes and failures when engaging it, that most impacts expectancies for success, values, and costs one associates with the behavior (Eccles et al., 1983). These perceptions are said to influence future behavior choices and persistence in tasks related to a specified behavior (Eccles et al., 1983).

Since its initial development, Eccles and colleagues have studied and refined the relationship between constructs presented in their model (Eccles, 1993, 2009; Eccles et al., 1983; Eccles & Wigfield, 2002; Wigfield & Eccles, 1992, 2000). The model holds that behaviors are impacted most directly by subjective task values and expectations for success. In turn, values and expectations for success are influenced by beliefs about one's abilities and self-schema, as well as one's identity beliefs. These self-perceptions are shaped by the beliefs of socializers (e.g., parents, peers), and an individual's perceptions of the expectations these socializers might have. Lastly, the model asserts that factors associated with the cultural milieu, such as gender or social roles, have a bearing on all other factors (Eccles, 1993, 2009; Eccles et al., 1983; Eccles & Wigfield, 2002; Wigfield & Eccles, 1992, 2000).

Expectancy Beliefs

The first of two constructs that Eccles and colleagues (1983) posit are directly related to behavioral task engagement is expectancy beliefs. Expectancy beliefs are defined as a measure of how well an individual believes they will do when engaging in a specified behavior in the near or distant future (Eccles & Wigfield, 2002; Wigfield & Eccles, 2000). The initial definition of expectancy beliefs distinguished between the concept of expectancies for success and competence or ability beliefs. Ability beliefs pertained specifically to an individual's perceptions of their own competence at the specified behavior, as well as how their abilities compared to those of peers, while expectancies for success concerned only an individual's assessment of success when engaging in the behavior (Eccles et al., 1983). However, attempts undertaken early in model development to operationally differentiate these variables via empirical study showed that the two were highly correlated and difficult for individuals to distinguish from one another (e.g., Eccles et al., 1983). Therefore, later updates to the model present them as conceptually different, but not "empirically distinguishable," and thus call for them to be measured as one and the same (Wigfield & Eccles, 2000, p. 74).

Subjective Task Values

Per the model, the second concept most closely-related to behavior is subjective task value (Eccles et al., 1983). Subjective task values are defined as the qualities that an individual associates with a specific task and how those qualities relate to one's needs, goals, and the value one ascribes to engaging in a specified task (Eccles et al., 1983; Wigfield & Cambria, 2010; Wigfield & Eccles, 2000). Because the evaluation of task desirability varies greatly from person to person, these values are termed 'subjective' within the model. Eccles et al. (1983) posited that there were three discrete types of subject values that each captured a particular quality of a given task: (a) attainment value, (b) intrinsic or interest value, and (c) utility value. In addition to these three values, they also considered a fourth factor, cost, that is related to the perceived negative implications of task engagement (Eccles et al., 1983).

Attainment value. Attainment value is the importance an individual ascribes to doing well at a chosen task (Eccles et al., 1983; Wigfield & Eccles, 1992). Attainment value is proposed to be a relevant factor to task selection because being successful at a task can support or undermine features of one's self-schema (e.g., femininity or masculinity, intelligence, or competence; Wigfield & Eccles, 1992). Self-schema is defined as general ideas about the self that are developed through past experience. Self-schemas provide information about the self and help an individual relate new information and experiences to their view of themselves (Eccles, 2009; Eccles et al., 1983). As such, tasks that provide the individual with opportunities to confirm a central aspect of one's self-schema are likely to have a higher attainment value than those that might challenge or be unrelated to self-schema beliefs. Theoretically, one is more likely to choose tasks with high attainment value and should demonstrate greater persistence when pursuing such tasks. For example, a female athlete might choose to engage in gymnastics over wrestling because, while both require similar body awareness and persistence to become skillful in, the former supports a feminine self-schema while the latter might disconfirm feelings of femininity, as wrestling is often seen as a traditionally masculine pursuit.

Intrinsic or interest value. Intrinsic value is the enjoyment one feels when engaging in a task, or the overall interest an individual has in an activity (Eccles et al., 1983; Wigfield & Eccles, 1992). Wigfield and Eccles (2000) noted that the construct shares commonalities with the intrinsic motivational aspect of Deci and Ryan's (1985) Self-Determination Theory. Both models propose that the more interesting the task is to an individual, the deeper and more ongoing one's engagement in the task should be.

Utility value. Utility value refers to the usefulness of a task within the context of contributing to an individual's near or long-term goals (Eccles et al., 1983; Wigfield & Eccles, 1992). Utility value is independent of the intrinsic interest one places on a task. For example, a soccer player may not enjoy running laps before practice, but may choose to engage in it because they understand that strong cardiovascular fitness is needed to be successful within the context of a soccer game. This concept is roughly analogous with the identified regulation portion of extrinsic motivation that was presented in self-determination theory (Deci & Ryan, 1985).

Wigfield and Cambria (2010) note, however, that while one does not need to place high interest value on a task in order for it to have high utility value, such tasks can still have deep connections to one's sense of self, such as playing a specific sport or working within a certain career field.

Cost. Though it is not a value itself, cost is conceptualized within expectancy-value theory as a component of subjective task value (Eccles & Harold, 1991). Cost refers to the perceived drawbacks of engaging in a task including the physical or mental effort required by a task, the time a task might take, and the fear of failure or even success (Eccles et al., 1983; Eccles & Harold, 1991; Wigfield & Eccles, 1992). Further, Eccles and colleagues (1983) asserted that cost is closely related to choice, as electing to engage in one task might preclude an individual from undertaking a different valued activity (Eccles et al., 1983; Wigfield & Cambria, 2010). Whereas the three subjective task values are thought to be positively related to task engagement, cost is generally considered to hinder it (Eccles & Harold, 1991). For example, an individual may place high utility value on running, but because the perceived costs of looking unfit in front of others and physical discomfort are also high, they may abstain from running, even though they acknowledge its health benefits.

Self-Schema and Identity

Though the expectancy-value model states that expectancy beliefs and subjective task values are the direct actors on behavioral task engagement, since its inception, the theory has recognized that such choices are not made in a vacuum. Rather, expectations for success, values, and costs associated with a behavior or task are shaped by an individual's personal goals and self-schema (Eccles, 2009; Eccles et al., 1983). As discussed above, self-schema are general identity beliefs about what kind of person an individual thinks themselves to be (Eccles, 2009).

Personal identity beliefs pertain strictly to the individual (e.g., athlete, bookworm), while collective identity beliefs pertain to an individual's self-perception as a member of a certain group or community (e.g., disability identity, ethnic identity, gender identity) (Eccles, 2009). In 2009, Eccles offered additional depth to the relationship between identity beliefs and behavior choices, stating that "choices are a primary mechanism through which individuals enact . . . and thus validate their identities" (p.79). Therefore, identity-supportive behaviors are more likely to be valued than behaviors that conflict with or are unrelated to central facets of one's identity. For example, entering a marathon with the goal of setting a personal best might have a strong attainment value for someone who identifies as a runner, while the same person might assign a high cost to socializing with friends because that time may constitute a lost opportunity to engage in running. Eccles (2009) also suggests that identity beliefs may also play a role in assigning utility and intrinsic values to a behavior. For example, engaging in supplemental training may not be enjoyable to someone who identifies as a runner, but it may have high utility if it supports running-related goals such as achieving a better race time. Perhaps most obviously, individuals who find running to be interesting and fun, rather than simply a way to stay in shape, are more likely to identify as runners, and choose to engage in behaviors associated with running, per the theory.

Expectancy-Value Theory & Physical Activity

Though expectancy-value theory has been used widely in academic contexts, it has been employed with less frequency within the domains of physical activity, physical education, and sport. Among youth populations, research has demonstrated significant positive relationships between expectancy beliefs, task values, and behavioral engagement (Cox & Whaley, 2004; Dempsey, Kimiecik, & Horn, 1993; Eccles & Harold, 1991; Zhu & Chen, 2010).

Among adult populations, studies using expectancy-value theory to explore physical activity, exercise, or sport behaviors have utilized populations of college students who are enrolled in physical education or physical activity classes (Chen & Liu, 2008, 2009; Gao, 2008; Gu, Solmon, Zhang, & Xiang, 2011; Linxuan & Lee 2008; Vernadakis, Kouli, Tsitskari, Gioftsidou, & Antoniou, 2014). For example, Chen and Liu (2008) examined perceptions of expectancy beliefs and values about college physical education classes among a population of 368 Chinese college students. Findings suggested significant relationships existed between intrinsic or interest value, utility value, and students' decisions to re-enroll in future physical education classes, which suggests that in keeping with the expectancy-value model, finding physical education classes interesting and useful were related to ongoing engagement (Chen & Liu, 2008). In a related mixed-methods inquiry using the same sample, Chen and Liu (2009) investigated the role of cost in participants' choices to re-enroll or discontinue physical education classes in the future and found that while 82% of participants reported perceiving some costs associated with continuing to take physical education classes, 92% of participants still planned to re-enroll. The authors suggested that this finding supports the relationships between task values and cost presented in expectancy-value theory (i.e., costs may be perceived by the individual, so long as they do not outweigh the value of a given task or behavior) (Chen & Liu, 2009).

A similar study by Gao (2008) conducted among 155 students enrolled in collegiate weight training classes measured the relationship between expectancy-value beliefs, intention to participate in weight training and performance in the weight training class. Correlational analyses indicated that expectancy beliefs and all three task values were significantly related to intention to engage in weight training after the conclusion of the academic course, while expectancy beliefs, attainment and interest values were related to performance on a test containing weight training tasks and knowledge. Further, regression analyses revealed that perceived importance (i.e., attainment value) and expectancy-beliefs predicted intentions for future participation in weight training, while intrinsic or interest value and utility value did not. Taken together, these findings partially support Eccles and colleagues' (1983) idea that perceived interest and importance of a task predict engagement, while expectancy beliefs may be better predictors of performance. The author did note, however, that the results only supported the role of interest in present engagement, and suggested that the role of intrinsic or interest value on future behavior required further consideration (Gao, 2008). Three additional studies examined relationships between expectancy-value beliefs and intentions to continue engaging in various types of exercise classes (Gu et al., 2011; Linxuan & Lee, 2008; Vernadakis et al., 2014). All three studies found significant positive relationships between all expectancy-value variables (i.e., expectancy beliefs, attainment, intrinsic or interest and utility values) and intentions to continue physical activity or physical education courses. In addition, all three studies found positive relationships between the expectancy-value variables themselves.

Only two studies included physical activity levels as a variable (Chen & Liu, 2008; Vernadakis et al., 2014). Vernadakis and colleagues (2014) investigated 232 college students' self-reported physical activity levels and their expectancy-value beliefs about both physical education classes and participation in exergames. Although expectancy-value beliefs differed somewhat between the two types of physical activities included in the research, results indicated that all physical education expectancy-value variables were positively related to higher physical activity levels, which supports the relationships put forth in the expectancy-value model (Vernadakis et al., 2014). The aforementioned study by Chen and Liu (2008) included self-initiated physical activity (i.e., physical activity that was not undertaken as part of the physical education classes in which all participants were enrolled). Interestingly, there was no relationship between enjoyment of physical education classes and self-initiated physical activity participation, and while utility value and interest were motivating factors in the intention to re-enroll in physical education classes, only attainment value was predictive of engagement in self-initiated physical activity (Chen & Liu, 2008). While this finding might seem to contrast with the expectancy-value model, it is important to recall that attainment value is conceptualized as the importance of an activity has because it supports beliefs about the self, such as self-schema and identity (Eccles et al., 1983). In this way, the decision to engage in self-initiated physical activity in addition to that undertaken in physical education classes is likely to support identity beliefs of those who consider themselves to be athletes, but would not support the self-beliefs of non-athletes or those who do not consider themselves to be active.

In conclusion, the expectancy-value model has been well-used within the context of physical activity because of its usefulness in explaining physical activity engagement and intention to be active (Chen & Liu, 2008, 2009; Cox & Whaley, 2004; Dempsey et. al, 1993; Eccles & Harold, 1991; Gu et al., 2011; Linxuan & Lee 2008; Vernadakis et al., 2014; Zhu & Chen, 2010). Despite its demonstrable utility, researchers have not employed it to investigate the motivational beliefs of individuals with visual impairments when approaching physical activity. Because of the numerous barriers adults with visual impairments experience, understanding their perceived expectations for success and the value they attribute to being physically active may be related to their decisions to engage in or abstain from physical activity (Jaarsma et al., 2014, Lee et al., 2014; Shaw et al., 2012).

CHAPTER III: RESEARCH METHODS

The purpose of this chapter is to discuss the methods that was used in each inquiry included herein. This dissertation was constructed using a manuscript approach, consisting of two separate studies. The first study was the development and factor analysis of an instrument to measure the strength of barriers to physical activity for adults with visual impairments. The second study used the validated barriers scale along with several other instruments to explore the relationship between barriers to physical activity, expectancy-value constructs, and physical activity behavior among adults with visual impairments. The research questions, participant information, descriptions of variables, data collection, measures, and analysis are presented separately for each study.

Study I

Purpose

Lee et al. (2014) constructed and tested a three level Likert-type instrument used to measure the frequency with which individuals with visual impairments experienced certain barriers to participating in physical activity, though it did not measure the strength with which each barrier impacted individuals' physical activity participation. To construct items (*n*=56 initially) for their instrument, they combined items drawn from two sources: first, a previous barriers questionnaire designed for use across various disability populations, and second, the results of focus group interviews with individuals with visual impairments. After confirmatory factor analyses and a Rasch analysis, the number of items was reduced to 43 and factors were further grouped into types of barrier. Categories included environmental factors, safety, knowledge, psychological aspect, health-related factors, personal matters, social influence, and visual impairment (Lee et al., 2014).

While this instrument has a number of strengths and provided a basis for the scale developed by the present study, it had several limitations. First, the 43 items included may be considered too burdensome to be used in conjunction with other multiple-item instruments when considering the modest sample sizes attracted by most studies conducted among a low-incidence population like those with visual impairments. While recommendations vary regarding the optimal number of items an instrument should have, evidence indicates that response rates are higher the less time they take to complete (Choi & Pak, 2005; Hartge & Cahill, 1998). Second, the instrument was designed to measure the frequency with which each barrier was experienced (i.e., "how often has lack of transportation prevented you from being physically active?"), rather than the magnitude each barrier had (i.e., "how much does access to transportation impact your ability to engage in physical activity?"). Measuring perceived magnitude can help address the question of impact: that is, a barrier may be reported frequently but not be perceived by the individual to be particularly impactful. Law, Petrenchik, King, and Hurley (2007) considered magnitude to mean the difference in perception between a barrier being a "little deal" or a "big deal" in the mind of the individual (p. 1638). Therefore, the purpose of this study was to develop and validate a brief scale designed to measure the magnitude of barriers to physical activity for use among adults with visual impairments. To address this, the primary research question for this study was as follows: is the newly-developed Barriers to Physical Activity for Adults with Visual Impairment (BPAAVI) scale a valid and reliable measure of perceived barriers to physical activity experienced by adults with visual impairments?

Participants and Sampling

Participants for this study were 201 adults recruited from registries of individuals with visual impairments who furnished their contact information for the purpose of taking part in research opportunities and social media groups for individuals with visual impairments. Following approval by the Institutional Review Board, a description of the research purpose and protocol, as well as a link to the online questionnaire was emailed to the director of each online registry. This information was embedded into the body of an email that was sent from each registry's email address to directory members. Researchers followed each registry's policies regarding the number of calls for participants for each study. Similarly, the call for participants was embedded into posts on social media groups for individuals with visual impairments that permitted the distribution of research recruitment information in their rules. At no time did researchers initiate contact with individual potential participants directly. The call for research included a brief statement informing recipients of the purpose and protocol for the study, as well as a link to an accessible online survey platform. Criteria for inclusion in the study were (a) being 18 to 65 years old at the time of data collection, (b) identifying as having a visual impairment, and (c) having access and ability to complete an online questionnaire. As this instrument was developed for use by adults with visual impairments, the restricted age range was an important criteria for participation because children under the age of eighteen and older adults may face additional age-related barriers not experienced by most working-aged adults.

Participants in the first phase of data collection were 213 adults with visual impairments (138 women, 69 men, one other). Five participants declined to disclose their gender identity. The mean age of participants at the time of data collection was 42.31 years (*SD* = 14.03). Most participants (*n* = 158, 74.2%) described their racial or ethnic background as White (non-Hispanic). Nearly half of participants (43.2%, *n* = 92) reported having a visual impairment level of light perception or less (i.e., B1). Nearly all participants reported living in either urban (*n* = 92, 43.2%) or suburban (*n* = 94, 44.1%) locations.

Participants in the second dataset were 214 adults (149 women, 64 men, one other). The mean age of participants was 43.14 years (*SD* = 13.67). Most participants reported identifying as White (non-Hispanic; *n* = 162; 75.7%), and just over half (*n* = 112; 52.3%) identified as having a visual impairment level of minimal to no light perception (i.e., B1). Participants largely resided in urban (*n* = 90; 42.1%) or suburban (*n* = 96; 44.9%) areas at the time of data collection.

Instrument Development

The BPAAVI scale was developed in three phases. The first phase consisted of item development. A battery of potential barriers to physical activity for adults with visual impairments was generated by the researcher. All potential items were drawn from previous empirical studies conducted within this population. Items from the earlier scales, including those constructed by Jaarsma et al. (2014), Lee et al. (2014), and Shaw et al. (2012) were included in the initial pool of potential barriers. In addition, results of a qualitative pilot study examining barriers to physical activity, identity beliefs, and expectancy-value constructs that was in review during the development of the current study was also a source of potential barriers. Barriers in the initial pool was reviewed independently by the author and research team who built a consensus regarding which items to include.

Next, content validity was established by submitting the draft of the BPAAVI to a panel of experts, including adults with visual impairments and researchers who were experts in the fields of adapted physical activity and sport and exercise psychology. The panel was asked to grade items on a scale of zero (i.e., not relevant/unclear) to four (i.e., highly relevant/clear) on the relevance and clarity of each item. In addition, there was space for experts to provide supplementary feedback as needed. Ratings were then collated by the author who, together with a research team composed of researchers in the field of adapted physical activity and sport and exercise psychology, formed a consensus around which items to include. This iteration of the instrument was included within proposal materials to present to the Institutional Review Board of Old Dominion University.

Samples used to conduct the third and fourth phases of scale development, exploratory and confirmatory data analyses, were drawn from two separate datasets. The first dataset was collected using the content-validated 30-item scale. Following the completion of data reduction via exploratory factor analysis, a 19-item instrument was deployed to a second sample for confirmatory factor analysis. The aforementioned demographic questionnaire was included in the online survey for each phase of data collection.

The same procedures were used across the first and second data collection for this study. For each phase, the instruments were hosted on an accessible survey platform to ensure that participants who used assistive technology such as screen readers or text magnification were able to complete all items. Accessibility was determined by sending a formatted sample of the instruments to a panel of experts on assistive technology, including individuals who themselves had visual impairments and used assistive technologies in their daily lives. Any necessary adjustments to the formatting of instrument items for ease of use were made prior to the release of the registry announcements.

Participants for each phase were recruited from registries of individuals with visual impairments who furnished their contact information for the purpose of taking part in research opportunities and from social media groups for individuals with visual impairments. Following approval by the Institutional Review Board of the author's university, a description of the research purpose and protocol, as well as a link to the online questionnaire were emailed to the director of each online registry who then forwarded the call for participants to directory members. The call for participants was also shared on social media groups for individuals with visual impairments that allow posts about research opportunities. The call for research included a brief statement informing recipients of the purpose and protocol for the study, as well as a link to an accessible online survey platform. Criteria for inclusion in the study included (a) being 18 to 65 years old at the time of data collection, (b) identifying as having a visual impairment, and (c) having access and ability to complete an online questionnaire. Because this instrument was developed for use by adults with visual impairments, the restricted age range was an important criterion for participation because children under the age of eighteen and older adults may face additional age-related barriers not experienced by most working-aged adults.

Before they could access the questionnaire itself, potential participants were taken to a welcome statement that included the purpose of the study, study protocols, and a consent statement. Potential participants were not able to proceed to the questionnaire itself without first consenting to participation by selecting the response box that stated that they read, understood, and agreed to the terms of the consent statement. Participants were able to discontinue participation at any time by leaving the questionnaire prior to completing all items.

Data Analysis

Exploratory factor analysis. An iterative testing method was used for the exploratory factor analyses of the 30 items. Kaiser Meyer Olkin (KMO) and Bartlett’s Test of Sphericity were conducted to test sampling adequacy and suitability for factor analysis. A significant Bartlett test and KMO > .80 is desirable (Tabachnick & Fidell, 2007). Next, a principal component extraction with oblique matrix rotation were undertaken for item reduction and to identify correlations between the underlying factors. Eigenvalues, scree-plots, patterns, commonalities, and cross-loadings for each iteration were examined and items with poor loadings ($\lambda < .50$) and those with cross-loadings across multiple factors were discarded until a parsimonious and logical factor loading pattern was found.

Confirmatory factor analysis. The retained items constituted the BPAAVI scale for phase two of the data collection and were analyzed using confirmatory factor analysis (CFA) to examine the loading patterns based on a priori model from the EFA. Model fit was assessed using the following fit indices: the χ^2 model test, Bentler's (1990) revised normed comparative fit index (CFI; > .95 great, > .90 acceptable), the root mean square error of approximation (RMSEA; < .05 great, .05–.10 acceptable, > .10 poor), and standardized root mean square residual (SRMR; < .09 acceptable). These indices of model fit (χ^2 test), absolute fit (SRMR, RMSEA), incremental fit (CFI), and their thresholds are generally accepted standards for confirmatory factor analyses (Byrne, 2010; Hair, Black, Babin, & Anderson, 2010; Hooper, Coughlan, & Mullen, 2008; Kline, 2011; Thompson, 2004). The analysis was conducted using EQS 6.3. Wald z and Lagrange's multiplier tests were also conducted to for model re-specification purposes. Based on the goodness of fit indices, an iterative approach was used to identify the model specification that fit the data. Lastly, the discriminant validity and reliability of the BPAAVI were assessed via composite reliability (CR), average variance extracted (AVE), maximum shared variance (MSV), and average shared variance (AVE). Per Hair and colleagues (2010), the recommended thresholds were as follows: reliability assessment (CR > .70), convergent validity (AVE > .50), and discriminant validity (MSV < ASV; ASV < AVE.)

Study II

Purpose and Research Questions

The second study included herein utilized a cross-sectional quantitative design. The purpose of this inquiry was to examine the relationship between barriers to physical activity, expectancy-value variables, and physical activity engagement among adults with visual impairments. Research questions include: (a) to what degree are barriers to physical activity related to the physical activity levels of adults with visual impairments, (b) to what degree are expectancy-value beliefs related to physical activity levels of adults with visual impairments, (c) to what degree are barriers to physical activity related to expectancy-value beliefs of adults with visual impairments?

Participants and Sampling

Following approval by the Institutional Review Board of Old Dominion University, participants were recruited from several online registries of individuals with visual impairments who have expressed interest in participating in research and social media pages for individuals with visual impairments. Information regarding recruitment was embedded into the body of an email that was sent from each registry's email address to directory members. Again, researchers observed each registry's policies regarding the number of calls for participants. Information about participant recruitment was embedded into posts on social media groups for individuals with visual impairments that permitted the distribution of research recruitment information in their rules. At no time did researchers initiate contact with individual potential participants directly. Criteria for inclusion in the study were (a) being over the age of 18 years of age at the time of data collection, (b) identifying as having a visual impairment, (c) having no other disabilities that might impact ability to participate in physical activity, and (d) having access and ability to complete an online questionnaire. Unlike the first phase of data collection, adults over the age of 65 were allowed to participate complete the questionnaire. In order to remain consistent with the parameters set during the first phase of data collection, participants who were over the age of 65 at the time of data collection were not included in this round of analysis, their data will, however, be used in a future investigation concerning barriers to physical activity for older adults with visual impairments. The age range (18-65) was because the focus of this study was working-age adults with visual impairments. Like their sighted peers, adults, children, and older adults (i.e., those 66 years or older) likely have different expectancy-value beliefs and experience different barriers to physical activity participation based on age. Again, those with additional disabilities that impact ambulation were not eligible to participate because it was difficult to isolate whether the relationships between variables are related to their visual impairment, to the additional disability, or to having multiple disabilities.

In total, 252 adults with visual impairments completed the questionnaires. Prior to data analysis, three participants who identified as having additional disabilities that impacted ambulation (i.e., being wheelchair users) were removed from the sample because of the inherent difficulty in ascertaining whether the relationships between variables were related to their visual impairment, to being wheelchair users, or to having multiple disabilities. Similarly, 35 participants who reported being over the age of 65 years at the time of data collection were removed from the sample because they were outside of the specified age range for the study. A final sample of 214 participants (149 women, 64 men, one other) were included in the analyses. Participants' mean age at the time of data collection was 43.14 years old (SD = 13.67). The majority of participants (n = 162; 75.7%) identified as White (non-Hispanic). Most participants (n = 112; 52.3%) reported having a visual acuity ranging from no light perception to minimal light perception but without the ability to recognize the shape of a hand from any distance or direction (i.e., B1; USABA, 2013). Most participants reported residing in either urban (n = 90; 42.1%) or suburban (n = 96; 44.9%) settings at the time of data collection.

Variables and Measures

To examine the relationships between adults with visual impairments' perceived barriers to physical activity, expectancy-value beliefs, and physical activity levels, it was important to define and measure variables accurately. Each variable was operationalized in accordance with the instrument that was used to measure it. Variables associated with perceived barriers to physical activity for adults with visual impairments and physical activity levels have each been validated for the population prior to use herein. Expectancy-value beliefs were measured using a modified version of a questionnaire that had been validated for adults who do not have disabilities, but not for adults with visual impairments. As such, a confirmatory factor analysis was undertaken to ensure validity of this instrument for this population.

Perceived barriers to physical activity. Participants' perceived barriers to physical activity were measured using a newly-developed instrument, the BPAAVI. This 12-item scale was designed to measure the magnitude of barriers to physical activity using a five point Likert-type scale. More detailed information regarding the development and validation of the BPAAVI is presented in a separate study. Participants were asked to rate how much each barrier item had impacted their physical activity engagement ranging from one (i.e., "no impact") to five (i.e., "large impact"). Prior to use in this analysis, items of the BPAAVI were subject to two rounds of data reduction including exploratory factor analysis, principal component analysis, and confirmatory factor analysis. The exploratory factor analysis resulted in a four-factor model with Cronbach's alpha levels ranging from .72 to .86, which met the threshold for adequate internal consistency. The confirmatory factor analysis further reduced the data and loaded items onto a three-factor model. Factors included (a) accessibility factors (e.g., lack of accessible equipment, facilities, and programming), (b) personal factors (e.g., being too busy to be active, being frustrated with one's progress in physical activity, and discomfort associated with physical activity), and (c) transportation factors (e.g., lack of safe or reliable transportation to fitness facilities). Five items in the scale pertain to accessibility barriers, four items pertain to personal barriers, and three pertain to transportation barriers. Cronbach's alpha for the retained 12-item scale was .85, which exceeds the accepted standard for good internal consistency.

Expectancy-value beliefs. Expectancy-value beliefs are derived from Eccles and colleagues (1983) expectancy-value model of motivation. Participants' perceived expectancy beliefs and the three types of task values (i.e., intrinsic or interest, attainment or importance, and utility values) associated with participating in physical activity were measured using a modified version of Eccles and Wigfield's (1995) Self- and Task-Perception Questionnaire (STPQ). This 12-item questionnaire utilized a seven point Likert-type scale that asks participants to rate their perceptions of items related to task values and expectancy beliefs. For example, on the item "How important is engaging in regular physical activity and exercise to you?" respondents selected the response ranging from 1 (i.e., "not important") to 7 (i.e., "very important") that they felt best reflected their beliefs about the importance of physical activity and exercise. Rather than utilizing a Likert-type matrix that features only numbers 1-7 for each item, the selectable options in this questionnaire utilized both a number (1-7) and a verbal descriptor (e.g., "not important", "somewhat important", very important") to enhance clarity and accessibility. The scale was split into two categories: perceived task values items and ability/expectancy-related items. The ability/expectancy section was unidimensional and had five items designed to capture beliefs about participants' ability beliefs and expectations for success with regard to physical activity and exercise. For example, one question about ability asked "How good at physical activity and exercise are you?" The perceived task values portion was further subcategorized into three dimensions by the types of values presented in the model (i.e., intrinsic or interest, attainment or importance, and utility). Two items addressed intrinsic and utility values, respectively, while three items pertained to attainment value or importance of physical activity and exercise. For all items, higher ratings indicated higher feelings of interest, importance, utility, and expectations of success.

While the STPQ was designed for use with children and adolescents in an academic setting, its modified version has been used successfully in other contexts, including physical activity for adult populations. In a study of university students' motivation toward weight training, Gao (2008) utilized a modified version of the STPQ and performed a confirmatory factor analysis to ensure an acceptable fit for the model within this population. In the model, each of the three types of task value were treated as its own factor, while expectancy-related beliefs were treated as a single fourth factor. Results of the confirmatory factor analysis indicated an acceptable model fit between a four-factor model and the study data, and Cronbach's alphas were 0.79, 0.79, 0.79, and 0.81, which indicated that each subscale possessed acceptable internal reliability (Gao, 2008). A second study by Gao (2009) conducted among college students regarding a dart-throwing task also using a similar version of the STPQ was also found to have acceptable reliability with Cronbach's alpha levels of 0.71 for expectancy-related beliefs and 0.76 for task values. These analyses indicate that the modified version of the STPQ is suitable for use with adult populations within the context of physical activity tasks.

Physical activity engagement. Physical activity levels were measured using the International Physical Activity Questionnaire-Short Form (IPAQ-SF) (Craig et al., 2003). This self-report questionnaire is a seven-day recall measure that asks participants to report how much time they spent engaging in various levels of physical activity during the previous week.

Physical activity level options include walking, moderate physical activity, and vigorous physical activity. The instrument includes both planned physical activity, such as exercise or recreation activities, as well as unplanned physical activity, like physical activity undertaken as part of an individual's workday or for the purposes of transportation. Currently, IPAQ-SF is one of the most commonly used self-report physical activity inventories and has established acceptable reliability ($\rho = 0.76$) and concurrent validity ($\rho = 0.67$) among sighted adults (Craig et al., 2003). The instrument has been widely used in studies pertaining to the physical activity levels of adults with visual impairments (Haegele, Famelia, & Lee, 2017; Haegele et al., 2018; Haegele et al., 2016; Marmeleira et al., 2014; Sadowska & Krzepota, 2015). Haegele et al. (2016) indicated that the IPAQ-SF had demonstrated "moderate and acceptable levels of criterion validity and user sensitivity for use with adults with visual impairments" (p. 6). Further, the instrument has showed moderate correlations with objective measures for this population (from $r = 0.38$ to $r = 0.57$) (Marmeleira et al., 2014; Sadowska & Krzepota, 2015).

Demographic questionnaire. Finally, a brief demographic questionnaire was included to gather data about participant characteristics. This instrument contained of six questions about participants' age, gender identity, racial or ethnic identity, visual impairment level, and the type of environment (i.e., rural, suburban, or urban) in which they resided. The final item contained two parts and first asked participants whether they experienced any disabilities in addition to their visual impairment, while the second open-ended prompt allowed participants to describe additional disabilities in as much detail as they wished to include.

Data Collection

Participants for this study were recruited in two ways. First, a call for participants was distributed to several online registries of individuals with visual impairments who had expressed interest in participating in research. In addition to online registries, the call for participants was distributed via social media pages for individuals with visual impairments. The call for participants included information about the purpose of the study, criteria for inclusion, and approximate time commitment for participation. Criteria for inclusion in the study included (a) being over the age of 17 but under the age of 66 years old at the time of data collection, (b) identifying as having a visual impairment, (c) having no other disabilities that might impact the ability to participate in physical activity, and (d) having access and ability to complete the questionnaires. The age range (18-65) was purposively selected because the focus of this study was working-age adults with visual impairments. Like their sighted peers, adults, children, and older adults (i.e., those 66 years or older) with visual impairments likely have different expectancy-value beliefs and experience different barriers to physical activity participation based on age.

The questionnaire was hosted on two accessible survey platforms to ensure that participants who use assistive technology, such as screen readers or text magnification, were able to complete all items. Accessibility was determined by sending a formatted sample of the questionnaire to a panel of experts on assistive technology, including individuals who themselves have visual impairments. Before they could access the questionnaire itself, potential participants were taken to a welcome statement that included the purpose of the study, the study protocol, and a consent statement. Potential participants were not able to proceed to the questionnaire itself without first consenting to participation by selecting the response box that stated that they read, understood, and agreed to the terms of the consent statement. Participants could discontinue participation at any time by leaving the questionnaire prior to completing all items. Though the majority of participants utilized online platforms to complete the questionnaire, participants who could not access the online questionnaire were given the option to (a) complete a text document (i.e., Microsoft Word) version of the questionnaire via email, or (b) complete the survey via telephone by having the researcher read the questions to the participant and enter their responses into the online questionnaire. In either instance, participants must have consented to participation prior to receiving an alternative version of the questionnaire. No participants elected to use the text document option, and three participants took the questionnaire by telephone. Only completed questionnaires were included in data analysis and results. All data collection procedures were reviewed and approved by the Institutional Review Board at the authors university affiliation.

Data Analysis

Participants reported an average of 1568.55 MET-min/week (*SD* = 1647.78). Mean reported accessibility barrier scores were 2.56 (*SD* = 1.18), personal barrier scores were 2.44 (*SD* = 1.01), and transportation barrier scores were 2.22 (*SD* = .95). Participants reported an average interest or intrinsic value score of 5.02 (*SD* = 1.69), an average attainment value score of 5.23 (*SD* = 1.39), and a mean utility value score of 6.00 (*SD* = 1.27). The mean reported score for the expectancy beliefs factor was 4.12 (*SD* = 1.45). Results of the Pearson product moment correlation indicated that there was a significant negative relationship between MET-min/week and mean scores across each of the barrier factors (accessibility barriers $r = -.19$, $p < .01$; personal barriers $r = -.22$, $p < .01$; transportation barriers $r = -.19$, $p < .01$). Conversely, MET-min/week were significantly positively associated with each of the expectancy-value factors (interest or intrinsic value $r = .36$, $p < .001$; attainment value $r = .25$, $p < .001$; utility value $r = .26$, $p < .001$; expectancy beliefs $r = .43$, $p < .001$). All BPAAVI factors were significantly positively correlated with each other, and STPQ factors had significant positive relationships.

Participant age was not significantly correlated with any other variable. See Table 1 for correlations between all variables.

Next, a confirmatory factor analysis was undertaken to assess the STPQ model, and to investigate any alternative models that may be statistically more viable than the earlier scale. Indices used to assess goodness-of-fit included: (a) the χ^2 model test, (b) Bentler's (1990) revised normed comparative fit index (CFI; > .95 great, > .90 acceptable), (c) the root mean square error of approximation (RMSEA; < .05 great, .05–.10 acceptable, > .10 poor), and (d) standardized root mean square residual (SRMR; < .09 acceptable). These indices reflect model fit (χ^2 test), absolute fit (SRMR, RMSEA), and incremental fit (CFI), and reflect accepted standards for confirmatory factor analyses (Byrne, 2010; Hair, Black, Babin, & Anderson, 2010; Hooper, Coughlan, & Mullen, 2008; Kline, 2011; Thompson, 2004). Results of the confirmatory factor analysis showed adequate data-model fit (see Table 2). Model A in Table 2 reflects all 12 items included in the initial questionnaire. However, deletion of one item under the attainment value factor (e5) resulted in significantly improvement in CFI and χ^2 ($|\Delta CFI|$ = .040; $\Delta \chi^2 = 56.164$, $p < .05$). This improvement is represented by Model B in Table 2. Loadings for the final 11-items retained in the model are represented in Figure 2.

A multiple regression analysis was used to examine how much BPAAVI factors, STPQ factors, age, gender identity, and visual impairment level might predict participants' MET-min/week. As shown in Table 3, the results of the regression analysis indicate that 20.30% of variance in MET-min/week was explained by the model ($F_{10, 198} = 6.30$, $p < .001$). The effect size ($f^2 = .25$) exceeds the standard for a medium effect size ($f^2 = .15$), per Cohen (1988). Two variables were significant positive predictors for total weekly MET minutes, mean interest or intrinsic value ($\beta = .26$, $p < .01$) and mean expectancy beliefs ($\beta = .33$, $p < .001$), while controlling for other factors.

CHAPTER IV: STUDY MANUSCRIPTS

The purpose of this chapter is to present each manuscript included in this dissertation. The manuscript for the first study, Development and Validation of a Barriers to Physical Activity Scale for Adults with Visual Impairments, is presented beginning on page 46. It was composed according to the authorship guidelines of *Adapted Physical Activity Quarterly*. The manuscript for study two, Barriers, Expectancy-Value Beliefs, and Physical Activity Engagement among Adults with Visual Impairments, follows the first manuscript starting on page 71. It was composed in keeping with the formatting guidelines of the *International Journal of Sport & Exercise Psychology* with regard to word count and general structure. Citations for each manuscript retain the style of the American Psychological Association for the sake of continuity.

Manuscript I

Development and Validation of a Barriers to Physical Activity Scale for Adults with Visual Impairments

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Abstract

Research indicates that individuals with visual impairments tend not to meet the physical activity guidelines for health promotion. Existing literature has identified barriers to physical activity as having the potential to impact the physical activity engagement of this population. Most studies of barriers to physical activity among populations with visual impairments have used instruments developed for other groups. Therefore, the purpose of this study was to develop and validate a brief scale designed to measure the magnitude of barriers to physical activity for use among adults with visual impairments. The instrument was developed in four phases: (a) item development, (b) content validity, (c) exploratory factor analysis, and (d) confirmatory factor analysis. Factor analyses yielded 12 items across three barrier factors (i.e., accessibility, personal, and transportation). The Barriers to Physical Activity for Adults with Visual Impairment scale is a valid and reliable measure of barriers to physical activity for this population.

Keywords: Exercise, Health Promotion, Disability, Blindness

Introduction

The impact of physical activity engagement on health has been well-researched (Arem et al., 2015; Cardinal, Kang, Farnsworth, & Welk, 2015; Centers for Disease Control and Prevention [CDC], 2014). Benefits of regular physical activity for adults include decreased risk of cardiovascular disease, depression, diabetes, hypertension, obesity, osteoporosis, stroke, and some cancers (CDC, 2014; Warburton et al., 2006). Because of the health-related benefits of regular engagement in physical activity, the CDC (2014) recommends that healthy adults ages 18 to 65 years engage in at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity each week. Despite this, research indicates that less than half of adults in the United States (US) meet the minimums prescribed by these guidelines (CDC, 2014).

While physical activity engagement among the general population has been examined at length, the physical activity levels of adults with visual impairments has been the subject of less investigation. Several studies have found that that most adults with visual impairments tend not to meet physical activity guidelines (Carroll et al., 2014; Holbrook, Caputo, Perry, Fuller, & Morgan, 2009; Holbrook, Kang, & Morgan, 2013; Marmeleira, Laranjo, Marques, & Pereira, 2014; Starkoff, Lenz, Lieberman, Foley, & Too, 2017). For example, a study of a convenience sample of 115 adults with visual impairments in the United States found that 21.7% of participants reported engaging in sufficient physical activity to meet the guidelines prescribed by the CDC (Starkoff et al., 2017). Alongside investigations of the physical activity levels of adults with visual impairments, several inquiries have attempted to understand variables that are related to physical activity engagement. Barriers (i.e., factors that inhibit physical activity participation), which are often divided into categories such as environmental, personal, or social, have been the subject of some attention (Jaarsma, Dekker, Koopmans, Dijkstra, & Geertzen, 2014; Lee, Zhu, Ackley-Holbrook, Brower, & McMurray, 2014; Shaw, Flack, Smale, & Gold, 2012). For example, in a study of 648 adults with visual impairments in the Netherlands, Jaarsma and colleagues (2014) found that transportation and lack of accessible options in the neighborhood were the most commonly experienced environmental barriers to physical activity. Being dependent on others to be active, lack of motivation to be active, and having a visual impairment were the most reported personal and social barriers to physical activity (Jaarsma et al., 2014). In a similar study of 204 Canadians with visual impairments, Shaw et al. (2012) reported that individuals with some usable vision were generally less impacted by barriers than were those with minimal to no light perception.

Because the needs and challenges of accessing physical activity-related variables differ across disability populations, focused measures designed with a specified group in mind are essential for investigating potential impacts on physical activity participation (Rimmer, Riley, Wang, Rauworth, & Jurkowski, 2004). While research examining barriers to physical activity among adults with visual impairments has grown in recent years, few studies have heeded recommendations to conduct targeted investigations using instruments developed for specific disability groups (Rimmer et al., 2004). For example, two of the studies discussed above used modified versions of earlier questionnaires for their inquiries (Jaarsma et al., 2014; Shaw et al., 2012). Shaw and colleagues (2012) used a 35-item instrument that adapted a Likert-type scale developed and validated for use with individuals with fibromyalgia by adding twelve new items that were intended to target vision-specific barriers. Using this instrument, participants were asked to rate how much each item had inhibited their physical activity levels on a 5-point scale. Shaw et al. (2012) did not report any analyses to measure the validity of their modified instrument, though they did note that the internal consistency of each subscale was found to be acceptable using Cronbach's alpha (α =.70-.84). In a similar study, Jaarsma et al. (2014) used a 30-question adapted version of a questionnaire designed for Dutch Paralympians who experienced a variety of disabilities to guide their inquiry. Rather than employing a Likert-type scale, this instrument asked participants whether they felt each item presented a barrier to them, but did not address the frequency or magnitude with which barriers occurred (Jaarsma et al., 2014). The authors did not address the questionnaire's validity or consistency in their report.

To date, just one study has developed a barriers instrument specifically for use for adults with visual impairments. Lee et al. (2014) constructed and validated a three level Likert-type instrument used to measure the frequency with which individuals with visual impairments experienced certain barriers to physical activity. To construct items (n=56 initially) for their instrument, they combined items drawn from two sources: first, a previous barriers questionnaire designed for use across various disability populations, and second, the results of focus group interviews with individuals with visual impairments. After confirmatory factor analyses and a Rasch analysis, the number of items was reduced to 43 and factors were further grouped into types of barrier. Categories included environmental factors, safety, knowledge, psychological aspect, health-related factors, personal matters, social influence, and visual impairment (Lee et al., 2014).

While the instrument created by Lee et al. (2014) was devised for use among individuals with visual impairments and provided a basis for the scale developed by the present study, it had several limitations. First, the 43 items included may be considered too burdensome to be used in conjunction with other multiple-item instruments when considering the modest sample sizes attracted by most studies conducted among a low-incidence population like those with visual impairments. While recommendations vary regarding the optimal number of items an instrument should have, evidence indicates that response rates are higher the less time participants take to complete (Choi & Pak, 2005; Hartge & Cahill, 1998). Second, the instrument was designed to measure the frequency with which barriers were experienced (i.e., "how often has lack of transportation prevented you from being physically active?"), rather than the magnitude barriers had (i.e., "how much does access to transportation impact your ability to engage in physical activity?"). Measuring perceived magnitude can help address the question of impact: that is, a barrier may be reported frequently but not be perceived by the individual to be particularly impactful. Law, Petrenchik, King, and Hurley (2007) considered magnitude to mean the difference in perception between a barrier being a "little deal" or a "big deal" in the mind of the individual (p. 1638). Therefore, the purpose of this study was to develop and validate a brief scale designed to measure the magnitude of barriers to physical activity for use among adults with visual impairments. To address this, the primary research question for this study was: is the Barriers to Physical Activity for Adults with Visual Impairment (BPAAVI) scale a valid and reliable measure of barriers to physical activity experienced by adults with visual impairments?

Methods

Instruments

Development of the barriers to physical activity for adults with visual impairments (BPAAVI) scale. The BPAAVI scale was developed in four phases: (a) item development, (b) content validity, (c) exploratory factor analysis, and (d) confirmatory factor analysis. In the first phase, item development, an array of potential barriers to physical activity for adults with visual impairments was generated by the researcher. Prospective items were drawn from previous empirical studies conducted focusing on this population. Items from the earlier scales, including those used by Jaarsma et al. (2014), Lee et al. (2014), and Shaw et al. (2012) were included in the initial pool of potential barriers. In addition to the aforementioned studies, results of a qualitative pilot study examining barriers to physical activity, identity beliefs, and expectancy-value constructs that is reported separately were also used to source potential scale items (Kirk & Haegele, in press). The compilation process yielded an initial 37 barriers items. The instrument utilized a five-point Likert-type scale in which each item asked participants to rate the magnitude to which they believed the barrier impacted their physical activity participation. Response options ranged from 1 ("no impact") to 5 ("large impact").

Next, content validity was addressed by submitting the BPAAVI to a panel of four experts, including adults with visual impairments and researchers who are experts in the fields of adapted physical activity and motivational psychology. The panel was asked to grade each item on its relevance and clarity. In addition to rating each item, experts were given the opportunity to include supplementary feedback about individual items as well as overall impressions of the scale. Ratings were collated by the author who, together with the research team, then revised the scale based on this feedback. This iteration of the instrument consisted of 30 items related to barriers to physical activity for adults with visual impairments.

Demographic questionnaire. In addition to the BPAAVI, a demographic questionnaire was used to collect data on participant information including age, gender identity, racial or ethnic identity, visual impairment level, and the environment in which participants resided at the time of data collection (i.e., rural, suburban, or urban). Visual impairment level was based on United States Association of Blind Athletes (2013) classifications, which were used to differentiate participants according to visual acuity and field including those with low vision (i.e., B4), those who meet the criteria for legal blindness (i.e., B3), those who have travel vision (i.e., B2), and those with minimal to no light perception (i.e., B1).

Data Collection

Samples used to conduct the third and fourth phases of scale development, exploratory and confirmatory data analyses, were drawn from two separate datasets. The first dataset was collected using the content-validated 30-item scale. Following the completion of data reduction via exploratory factor analysis, a 19-item instrument was deployed to a second sample for confirmatory factor analysis. The aforementioned demographic questionnaire was included in the online survey for both data collections.

The same procedures were used across the first and second data collection for this study. For each phase, the instruments were hosted on an accessible survey platform to ensure that participants who used assistive technology (e.g., screen readers, text magnification) were able to complete all items. Accessibility was determined by sending a formatted sample of the instruments to a panel of experts on assistive technology, including individuals who themselves had visual impairments and used assistive technologies in their daily lives. Any necessary adjustments to the formatting of instrument items for ease of use were made prior to the release of the registry announcements.

Participants for each phase were recruited from registries of individuals with visual impairments who furnished their contact information in order to take part in research opportunities and from social media groups for individuals with visual impairments. Following approval by the Institutional Review Board of the author's university, a description of the research purpose and protocol, as well as a link to the online questionnaire were emailed to the director of each online registry who then forwarded the call for participants to directory members. The call for participants was also shared on social media groups for individuals with visual impairments that allowed posts about research opportunities. The call for research included a brief statement informing recipients of the purpose and protocol for the study, as well as a link to an accessible online survey platform. Criteria for inclusion in the study included (a) being 18 to 65 years old at the time of data collection, (b) identifying as having a visual impairment, and (c) having access and ability to complete an online questionnaire. Because this instrument was developed for use by adults with visual impairments, the restricted age range was an important criterion for participation because children under the age of eighteen and older adults may face additional age-related barriers not experienced by most working-aged adults.

Before they could access the questionnaire itself, potential participants were taken to a welcome statement that included the purpose of the study, study protocols, and a consent statement. Potential participants could not proceed to the questionnaire itself without consenting to participation by selecting the response box that stated that they read, understood, and agreed to the terms of the consent statement. Participants could discontinue participation at any time by leaving the questionnaire prior to completing all items.

Data Analysis

Exploratory factor analysis. An iterative testing method was used for the exploratory factor analyses of the 30 items. Kaiser Meyer Olkin (KMO) and Bartlett's Test of Sphericity were conducted to test sampling adequacy and suitability for factor analysis. A significant Bartlett test and KMO > .80 is desirable (Tabachnick & Fidell, 2007). Next, a principal component extraction with oblique matrix rotation were undertaken for item reduction and to identify correlations between the underlying factors. Eigenvalues, scree-plots, patterns, commonalities, and cross-loadings for each iteration were examined and items with poor loadings ($\lambda < .50$) and those with cross-loadings across multiple factors were discarded until a parsimonious and logical factor loading pattern was found.

Confirmatory factor analysis. The retained items constituted the BPAAVI scale for phase two of the data collection and were analyzed using confirmatory factor analysis (CFA) to examine the loading patterns based on a priori model from the EFA. Model fit was assessed using the following fit indices: the χ^2 model test, Bentler's (1990) revised normed comparative fit index (CFI; > .95 great, > .90 acceptable), the root mean square error of approximation (RMSEA; < .05 great, .05–.10 acceptable, > .10 poor), and standardized root mean square residual (SRMR; < .09 acceptable). These indices of model fit (χ^2 test), absolute fit (SRMR, RMSEA), incremental fit (CFI), and their thresholds are generally accepted standards for confirmatory factor analyses (Byrne, 2010; Hair, Black, Babin, & Anderson, 2010; Hooper, Coughlan, & Mullen, 2008; Kline, 2011; Thompson, 2004). The analysis was conducted using EQS 6.3. Wald z and Lagrange's multiplier tests were also conducted to for model re-specification purposes. Based on the goodness of fit indices, an iterative approach was used to identify the model specification that fit the data. Lastly, the discriminant validity and reliability of the BPAAVI were assessed via composite reliability (CR), average variance extracted (AVE), maximum shared variance (MSV), and average shared variance (AVE).

Results

Participant Characteristics

Data collection one. Participants in the first phase of data collection were 213 adults with visual impairments (138 women, 69 men, one other). Five participants declined to disclose their gender identity. The mean age of participants at the time of data collection was 42.31 years (*SD* = 14.03). Most participants (*n* = 158, 74.2%) described their racial or ethnic background as White (non-Hispanic). Nearly half of participants (43.2%, *n* = 92) reported having a visual impairment level of light perception or less (i.e., B1). Nearly all participants reported living in either urban (*n* = 92, 43.2%) or suburban (*n* = 94, 44.1%) locations.

Data collection two. Participants in the second dataset were 214 adults (149 women, 64 men, one other). The mean age of participants was 43.14 years (*SD* = 13.67). Most participants reported identifying as White (non-Hispanic; *n* = 162; 75.7%), and just over half (*n* = 112; 52.3%) identified as having a visual impairment level of minimal to no light perception (i.e., B1). Participants largely resided in urban (*n* = 90; 42.1%) or suburban (*n* = 96; 44.9%) areas at the time of data collection. Full participant characteristics from both data collections can be found in Table 1.

Exploratory Factor Analyses

Responses from the first dataset were analyzed via exploratory factor analysis to investigate underlying factors in order to build a model for further analysis. Exploratory factor analyses were iteratively undertaken for purposes of data reduction and to ensure model fit. For each iteration of the model, the result of the Kaiser Meyer Olkin (KMO) and Barlett's Tests of Sphericity were first performed to determine that instrument items were suitable for exploratory factor analysis (Guadagnoli & Velicer, 1988; Tabachnick & Fidell, 2007). For each model, principal component analyses were conducted to determine a preliminary factor solutions. The number of factors suggested in each iteration of the model was based on Eigenvalues that exceeded Kaiser's criterion of 1 and scree plot analysis. In each step, the model was rotated using an oblimin rotation with Kaiser normalization. Items with low loadings ($\lambda < .50$) on multiple factors were eliminated. This process was repeated three times until a suitable factor solution with adequate loadings ($\lambda >.50$) with minimal cross-loadings was found. See Table 2 for a detailed description of the EFA process.

Finally, the factor structure of the retained 19 items was assessed. KMO for model C was .85, and BTS was again significant (χ^2 (171) =1542.67, $p < .001$). The principal components analysis explained 60.97% of variance. Oblimin rotation with Kaiser normalization of model C showed improved fit overall with adequate loading ($\lambda > .50$). Only one item (q14) demonstrated any cross-loading on more than one factor, however, it was retained because it only met the .50 threshold for one factor. In total, 19 items were retained and loaded onto a four-factor model. See Table 3 for item loadings for model C of the exploratory factor analysis.

Confirmatory Factor Analysis

The EFA resulted in a factor reduction, item removal, and addition of error term correlations. Confirmatory factor analyses were conducted until the CFI and RMSEA thresholds specified by Bentler (1990) were satisfied, resulting in eight iterations of the model. Prior to model A, EQS software was unable to generate an adequate model due to a covariance of two items loaded onto factor one (q7, q8). Because the two items made statements that could be logically related (e.g., "Fitness or physical activity staff is not trained," and "There are no programs to help me learn to exercise") a covariance path between the items was added based on a Lagrange multiplier test. While this analysis produced a functional model (A), it did not meet the specified standards for goodness-of-fit (CFI = .676; RMSEA = .074). To improve goodness-of-fit throughout model-building iterations B-F, items were discarded due to poor loadings, while others that were logically linked were allowed to co-vary based on Lagrange multiplier test recommendations. In model G, factor three contained only three items (q12, q13, q18). The loadings for the factor were weak, and the decision was made to remove the entire factor from the model. A detailed description of the CFA procedure is presented in Table 4. Model H represents the final iteration of the BPAAVI (CFI = .917 RMSEA = .064) and shows the remaining three factor, 12-item instrument (see Figure 1). Standardized items and factor loadings for each item are presented in Table 5. Discriminant validity and reliability are described in Table 6.

Discussion

The purpose of this study was to develop and validate a brief scale designed to measure the magnitude of barriers to physical activity for use among adults with visual impairments. The instrument was developed in four phases: (a) item development, (b) content validity, (c) exploratory factor analysis, and (d) confirmatory factor analysis. Results yielded a 12-item, three-factor model useful for measuring barriers related accessibility, personal issues, and transportation concerns to physical activity engagement for adults who have visual impairments. Exploratory factor analyses resulted in a large amount of data reduction from the initial 30 items to 19 items across four factors. One factor and seven items were discarded during confirmatory factor analysis due to poor fit and unacceptable loadings across factors.

The factors of the final model were examined again for logical validity and assigned category names deemed appropriate based on item makeup. Accessibility barriers were related to ease of use of facilities (e.g., locker rooms, equipment, and the built environment of fitness facilities) and availability of appropriate programming and expertise (e.g., programs designed for beginners and fitness staff trained to work with individuals with visual impairments). Items that composed the accessibility factor in the present study were similar to those presented by Lee at al. (2014) as accessibility barriers (e.g., lack of accessible equipment, lack of trained staff, and physically inaccessible facilities). However, the accessibility factor presented herein eliminated several items whose analogs were retained in the previously constructed instrument such as “lack of a place to exercise with other individuals having similar disabilities” and “not knowing how to use equipment" (Lee et al., 2014, p. 317). Personal barriers were related to self-beliefs about engaging in physical activity (e.g., lack of discipline, frustration at lack of improvement) interest in physical activity (e.g., dislike of physical activity, preferences for other activities). In contrast to the single factor identified as personal barriers in the current study, Lee and colleagues (2014) divided a pool of similar items into two factors: personal matters (e.g., time constraints, cost of activity) and psychological barriers (e.g., lack of interest, lack of self-discipline). Transportation barriers included items related to nearness of facilities, lack of transportation, and the perceived usability of available transportation options. Lee et al. (2014) also included items that pertained to transportation, however they were distributed across several factors including personal matters, sight-specific barriers, and safety barriers. The fourth factor, which was discarded during the model-building process of the confirmatory factor analysis, contained items mostly related to perceived safety (e.g., fear of injury, fear of getting lost when accessing a physical activity facility). The final three factors were found to covary. Perhaps not surprisingly, covariance between accessibility and transportation factors was the strongest, which could be expected given the logical similarities of items related constraints related to transportation to physical activity facilities and issues surrounding appropriateness and usability for individuals with visual impairments of such facilities themselves.

Interestingly, items related to having a visual impairment and safety concerns that could be logically related to having a visual impairment (e.g., the eliminated safety factor), were not well-fit to the model. This finding is supported by an earlier study conducted by Lee et al. (2014), wherein participants reported experiencing barriers related to sight-specific and safety concerns infrequently. While it may seem counterintuitive that such barriers have historically not been considered impactful, perhaps this finding aligns with the social model of disability, which posits that it is not the presence of impairment itself that creates a problem, but rather the difficulties navigating a society—both with regard to physical structure and lack of opportunity for participation—designed by and for individuals without disabilities that results in the quality of being disabled (Smith & Perrier, 2014).

The findings of the current study have two main implications. First, the validation of the BPAAVI provides insight into the factorial makeup of relevant items that present barriers to physical activity for individuals with visual impairments. Prior studies concerning barriers to physical activity have utilized a largely descriptive methodology about the perceived barriers to physical activity and sport among adults with visual impairments and did not make inferential associations between barriers and actual physical activity engagement (Jaarsma et al., 2014; Lee et al., 2014). The present scale may be used to examine relationships between perceived barriers to physical activity and actual physical activity engagement to better understand the role of barriers for this population. As the first instrument validated for adults with visual impairments that measures the magnitude of potential barriers, the BPAAVI may be used to address the concept of perceived impact of a barrier by answering the question of “how much” rather than “how often” the respondent perceives a barrier (Law et al., 2007).

Second, because of the relatively small number of factors and items in the final instrument, this scale offers utility for use alongside other instruments or questionnaires with lessened risk of participant fatigue when compared to other instruments that contain more items. Though there is no universal threshold for number of items in an instrument, there is evidence to suggest that self-guided surveys yield greater responses when they take less time to complete (Choi & Pak, 2005; Hartge & Cahill, 1998). Potential avenues for meaningful investigations of barriers alongside other variables include socio-demographic variables such as age, racial or ethnic identity, visual impairment level, education level, income level, or residential environment that might impact the magnitude with which barriers are perceived, or the relationship between barriers, socio-demographic variables, and physical activity engagement. Another use of the BPAAVI would be to examine possible associations between barriers to physical activity and other motivational variables associated with physical activity, such as self-efficacy or expectancy-value beliefs regarding physical activity.

This study has several limitations. The sample sizes of around 200 participants for each phase of data collection presented additional challenges due to distortions such as cross-loadings and model errors, wherein certain items that were inconsistently reported among this group and were discarded may have had better loadings with a larger sample (Mundfrom, Shaw, & Ke, 2005). However, recommendations set forth by de Winter, Dodou, and Wieringa (2009) affirm that even small sample sizes (N =50) may yield reliable results, even with distortions. Secondly, the average variance extracted for the accessibility factor was lower than recommended for adequate convergent validity (Hair et al., 2010). However, because the composite reliability of the factor (.804) exceeded the recommended threshold of .60, its convergent validity can still be considered adequate (Fornell & Larker, 1981). With regard to sampling, because the physical activity participation was clearly identified in the description of the study, it may have attracted more participants who were interested and involved in physical activity, therefore, barriers may have been reported as less impactful that they may actually be within the population of adults with visual impairment at large. Finally, participants in each phase of data collection largely identified as White, female, urban and suburbanites, while other ethnic groups, males, and rural dwellers were underrepresented, so the generalizability of the instrument to different groups of individuals with visual impairments should become a topic of further inquiry.

In summary, the BPAAVI is a valid measure of barriers to physical activity for adults with visual impairments. Results of the present study show support for the psychometric properties, validity, and reliability of the instrument. The 12-item, three factor model may be used to measure barriers to physical activity in isolation or alongside various other scales within the context of adapted physical activity research.

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Table 1. Participant characteristics for data collections one and two.

	Data Collection 1		Data Collection 2	
	N (%)	Mean (SD)	*N* (%)	Mean (SD)
Age	201 (94.4)	42.31 (14.03)	214	43.14 (13.67)
Did not answer	12 (5.6)			
Gender Identity				
Female	138 (64.8)		149 (69.6)	
Male	69 (32.4)		64 (29.9)	
Other	1 (.5)		1 (.5)	
Did not answer	5 (2.3)			
Race/Ethnic Identity				
African American/Black	11 (5.2)		9 (4.2)	
Asian/Pacific Islander	12 (5.6)		12 (5.6)	
Hispanic/Latino	17 (8.0)		20 (9.3)	
Native American	2 (.9)		1 (.5)	
White (Non-Hispanic)	158 (74.2)		162 (75.7)	
Other	12 (5.6)		10 (4.7)	
Did not answer	1 (.5)			
Visual Impairment Level				
B1	92 (43.2)		112 (52.3)	
B2	39 (18.3)		41 (19.1)	
B3	62 (29.1)		52 (24.3)	
B4	14 (6.6)		9 (4.2)	
Did not answer	6 (2.8)			
Living Environment				
Urban	92 (43.2)		90 (42.1)	
Suburban	94 (44.1)		96 (44.9)	
Rural	24 (11.3)		28 (13.1)	
Did not answer	3 (1.4)			

Table 2. EFA model development for BPAAVI.

EFA Model	Factors	Qs Eliminated	KMO	χ^2	df	Percent of Variance
A	6	-	0.88	2744.91**	435	60.82%
B	5	9, 10, 11, 12, 22, 23, 24, 25, 27	0.96	1900.48**	231	65.05%
C	4	18, 26	0.85	1542.67**	171	60.97%

Note. Qs = items; KMO = Kaiser Meyer Olkin; χ^2 = Bartlett's Test of Sphericity. $p^{**} < .001$

Table 3. Four-factor exploratory factor analysis for BPAAVI, maximum likelihood extraction, oblimin rotation.

	λ^2	λ Factor 1	Factor 2	Factor 3	Factor 4
5. Equipment available to me is not accessible	.73	.94			
7. Fitness or physical activity staff is not trained	.67	.94			
8. There are no programs to help me learn to exercise	.68	.74			
4. Facilities near me are not accessible	.61	.68			
6. The locker rooms are not accessible	.55	.58			
3. There are no adapted activities near me	.56	.57			
19. I am too tired from daily activities to be physically active	.67		.87		
13. My lack of discipline when maintaining physical activity	.64		.83		
21. I am too busy with other activities to be physically active	.56		.78		
14. I don't enjoy being physically active	.57		.64		-.43
17. I become fatigued or uncomfortable when being active	.51		.63		
20. I am frustrated with my lack of improvement at physical activity	.59		.58		
16. I am too old to be physically active	.62			-.81	
28. I'm afraid I'll be injured	.62			-.77	
29. I'm afraid I'll get lost	.57			-.76	
15. I am in poor health	.64			-.60	
2. There are no fitness facilities near me	.67				.79
30. I feel that my transportation options to access facilities are unsafe	.63				.68
1. I don't have access to reliable transportation.	.51				.67
Eigenvalues		6.06	2.80	1.60	1.14
Percent of Variance		31.91	46.63	54.98	60.97
Cronbach's α		.86	.83	.74	.72

Note. λ^2 = communalities; λ = factor loadings. Only factor loadings > .40 were included in the table.

Table 4. Baseline CFA models for BPAAVI.

		Goodness-of-Fit indices					Model comparison	
CFA Model	Description	*YB* X^2	*df*	*CFI*	*RMSEA (90% CI)*	*SRMR*	*ΔCFI*	*Δ*X^2
A		313.870	145	.676	.074 (.063, .085)	.090	-	-
B	elim q18	265.856	153	.734	.072 (.060, .084)	.083	.058	48.014**
C	cov q5, q6	270.065	126	.730	.073 (.061, .085)	.083	.004	-4.209**
D	elim q13	221.490	110	.782	.069 (.056, .082)	.080	.052	23.277**
E	elim q3	198.213	95	.785	.071 (.057, .085)	.079	.003	48.575**
F	elim q17	157.105	81	.843	.066 (.051, .082)	.078	.058	23.277**
G	elim F3	115.629	59	.886	.067 (.049, .085)	.069	.043	41.108**
H	elim q14	90.164	48	.917	.064 (.043, 084)	.065	.031	41.476**

Note. CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; 90% CI = 90% confidence interval; SRMR = Standardized Root Mean-Square Residual. **$p < .001$

Table 5. Standardized items and factor loadings for BPAAVI.

Barrier Factor	Estimate	SE
Accessibility		
4. Facilities near me are not accessible	.85	.07
5. Equipment available to me is not accessible	.85	
6. The locker rooms are not accessible	.65	.08
7. Fitness or physical activity staff is not trained	.66	.07
8. There are no programs to help me learn to exercise	.64	.07
Personal		
9. My lack of discipline when maintaining physical activity	.68	.15
10. I don't enjoy being physically active	.70	.14
15. I am frustrated with my lack of improvement at physical activity	.67	
16. I am too busy with other activities to be physically active	.49	.10
Transportation		
1. I don't have access to reliable transportation.	.62	.14
2. There are no fitness facilities near me	.70	
19. I feel that my transportation options to access facilities are unsafe	.49	.11

Note. SE = Standard Error.

Table 6. Discriminant validity and reliability of BPAAVI constructs

Construct	CR	AVE	MSV	ASV
Accessibility	.804	.459	.476	.363
Personal	.851	.590	.250	.226
Transportation	.837	.633	.476	.339

Note. CR = Composite Reliability; AVE = Average Variance Extracted; MSV = Maximum Shared Variance; ASV = Average Shared Variance.

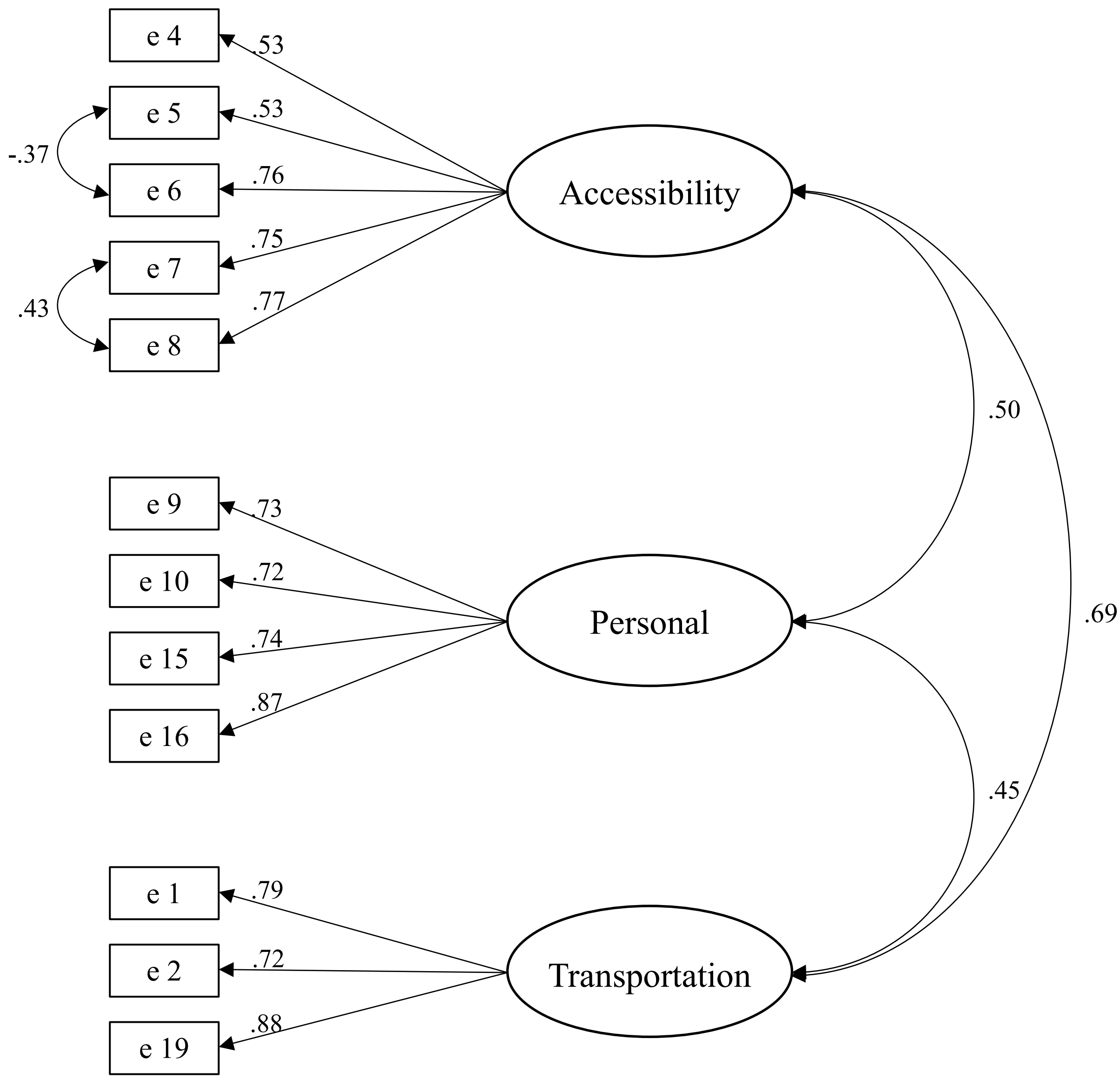

Figure 1. Final 12-item BPAAVI with error covariation and standard estimates.

Manuscript II

Barriers, Expectancy-Value Beliefs, and Physical Activity Engagement among Adults with Visual Impairments

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Abstract

Evidence suggests that adults with visual impairments tend not to engage in sufficient physical activity for health promotion, but few studies have investigated the role motivational factors might play regarding decisions to be physically active. Research among populations without disabilities has shown the usefulness of expectancy-value theory for understanding engagement in volitional physical activity, however no quantitative research has utilized this framework for adults with visual impairments to date. Therefore, the purpose of this inquiry was to examine the relationship between barriers to physical activity, expectancy-value variables, and physical activity engagement among adults with visual impairments. A total of 214 participants (Mage = 43.14; 69.6% female) completed the Barriers to Physical Activity for Adults with Visual Impairments, the Self- and Task-Perception Questionnaire, the International Physical Activity Questionnaire-Short Form, and a demographic questionnaire. Associations between variables were explored via correlation and regression analyses. Positive relationships were found between expectancy-value variables and physical activity engagement, while barriers to physical activity and physical activity engagement were negatively correlated. A significant amount of variance (20.30%) in physical activity engagement was explained by the model. Intrinsic or interest value and expectancy beliefs each emerged as significant predictors of physical activity engagement, which suggests that expectancy-value theory may have some utility for investigating the physical activity engagement of individuals with visual impairments. However, the lack of significant contribution of other variables, such as attainment and utility values as well as barriers factors, underscore the need for additional research in this area.

Keywords: Exercise, Health Promotion, Disability, Blindness**,** Motivation

Introduction

Physical activity has been linked to disease prevention and improved mental and physical health (Centers for Disease Control and Prevention [CDC], 2014; Warburton, Nicol, & Bredin, 2006). For example, regular engagement in physical activity can lead to decreased chances of developing cardiovascular disease, depression, diabetes, hypertension, obesity, osteoporosis, stroke, and some cancers (CDC, 2014; Warburton et al., 2006). Despite this, reports indicate that the majority of adults with visual impairments do not typically meet physical activity guidelines (Carroll et al., 2014; Holbrook, Caputo, Perry, Fuller, & Morgan, 2009; Holbrook, Kang, & Morgan, 2013; Marmeleira, Laranjo, Marques, & Pereira, 2014; Starkoff, Lenz, Lieberman, Foley, & Too, 2017). Because adults with visual impairments tend not to meet physical activity guidelines, they are unlikely to experience associated health-related benefits. For example, Crews and Campell (2002) found associations between having a visual impairment and increased risk factors for obesity-related health conditions. Further, those with visual impairments have higher average body mass index scores and are more likely to be overweight or obese than their sighted peers (Crews & Campbell, 2002; Holbrook et al., 2009)

In recent years, several inquiries have attempted to understand variables that are related to physical activity engagement among adults with visual impairments. Socio-demographic variables such as age, gender, racial or ethnic background, and visual impairment level have been well-researched, although the results are not definitive (Barbosa Porcellis da Silva et al., 2017; Haegele, Zhu, Lee, & Lieberman, 2016; Holbrook et al., 2009; Starkoff et al., 2017). For example, several studies have found differences in the intensity of overall engagement in physical activity across visual impairment levels (Barbosa Porcellis da Silva et al., 2017; Starkoff et al., 2017), while others have found no differences in average physical activity across visual impairment levels (Haegele et al., 2016; Haegele, Kirk, & Zhu, 2018; Holbrook et al., 2009). Similarly, some studies found that maleness was associated with significantly higher physical activity levels (Haegele et al., 2016; Starkoff et al., 2017), while others found no significant differences across gender identities (Haegele et al., 2018; Holbrook et al., 2009). In addition to socio-demographic variables, barriers, or factors that inhibit physical activity participation, have been the subject of some attention in research examining physical activity among persons with visual impairments. For example, a study of 648 Dutch adults with visual impairments found that transportation and a lack of accessible options in the neighborhood were among the most reported environmental barriers to physical activity, while dependence on others, lack of motivation toward physical activity, and having a visual impairment were the most common personal and social barriers (Jaarsma et al., 2014). A similar study by Shaw et al. (2012) conducted among Canadian teens and adults with visual impairments concluded that structural constraints (i.e., environmental barriers) were the perceived to have a greater inhibitive impact on physical activity than sight-specific, intrapersonal (i.e., psychological), or interpersonal barriers (Shaw et al., 2012). To date, just one study has measured physical activity engagement alongside barriers to physical activity. Shaw and colleagues (2012) investigated the relationship of constraints (i.e., barriers) to physical activity engagement and found that constraints were significantly negatively related to physical activity participation.

In addition to socio-demographic variables and barriers, motivational factors associated with physical activity engagement among adults with visual impairments have also been the subject of some investigation. For example, Haegele, Hodge, and Kozub (2017) utilized the theory of planned behavior, a belief-to-behavior model of understanding motivation, to examine the relationship between intentions to be physically active and physical activity engagement among adults with visual impairments. Results of this study indicated that consistent with the theoretical model, one dimension of the model, intention to be physically active, was predictive of physical activity engagement (Haegele et al., 2017). In addition to theory of planned behavior, two studies have used social cognitive theory to examine the relationship between motivation and physical activity (Haegele, Brian, & Lieberman, 2017; Haegele et al., 2018). Haegele, Brian et al. (2017) found that social supports were positively associated with physical activity engagement among a sample of adults with visual impairments, and Haegele et al. (2018) found that adults with visual impairments who reported higher self-efficacy were more likely to report being more physically active than those who were not as self-efficacious. Though these findings have provided some information about the relationship between motivational beliefs and physical activity amongst this population, additional investigation into this phenomenon from a theory-based perspective may provide further insight into the role of motivational factors in physical activity contexts for adults with visual impairments. One theoretical model that could add to the growing body of knowledge in motivation and physical activity among adults with visual impairments is expectancy-value theory.

Expectancy-Value Theory of Motivation

Expectancy-value theory was developed in the field of educational psychology beginning in 1983, and has been continually employed across different motivational contexts since then (Eccles et al., 1983; Eccles & Wigfield, 2002; Wigfield & Cambria, 2010; Wigfield & Eccles, 2000). In essence, expectancy-value theory posits that the more one values a behavior and believes that they will be successful at it, the more likely they are to choose to engage in it (Eccles et al., 1983). To investigate these relationships, Eccles and colleagues (1983) defined and developed two constructs that act as direct influencers on behavior, as well as a host of constructs that have an indirect impact on behavior.

The first construct that is said to be directly related to the behavior is termed expectancy beliefs (Eccles et al., 1983). Expectancy beliefs are a unidimensional construct that refer to both how well one believes that they will do when performing a specific behavior, as well as how competent one believes they are at the activity itself (Eccles et al., 1983; Wigfield & Eccles, 2000). Per the model, the second construct that has a direct impact on the behavior is that of subjective task values, or the qualities one associates with a behavior or task that give it importance (Eccles et al., 1983). Unlike expectancy beliefs, subjective task values are multi-dimensional and include (a) attainment value, (b) intrinsic or interest value, and (c) utility value. Each type of value is intended to capture a unique type of importance a behavior or task may hold for an individual (Eccles et al., 1983; Eccles & Wigfield, 2002). Attainment value relates to the importance one ascribes to doing well at a task and how such an achievement supports the individual's feelings about the type of person they are (Eccles et al., 1983; Wigfield & Eccles, 2000). Intrinsic or interest value is defined as the enjoyment associated with engaging in a task or behavior, as well as the general interest one has in participating in it (Eccles et al., 1983; Wigfield & Eccles, 2000). Utility value refers to the perceived usefulness of a task or activity, particularly with regard to an individual's near or long-term goals (Eccles et al., 1983).

Though expectancy-value theory has been used widely in academic contexts, it has also been employed within the domains of physical activity, physical education, and sport. Among adult populations, studies using expectancy-value theory to explore physical activity, exercise, or sport behaviors have utilized populations of college students who are enrolled in physical education or physical activity classes (Chen & Liu, 2008; Gao, 2008; Vernadakis, Kouli, Tsitskari, Gioftsidou, & Antoniou, 2014). For example, in a study of 368 college students enrolled in physical education classes, Chen and Liu (2008) found significant relationships between intrinsic or interest value, utility value, and students' decisions to re-enroll in future physical education classes, which suggests that in keeping with the expectancy-value model, finding physical education classes interesting and useful were related to ongoing engagement. A similar study by Gao (2008) conducted among 155 students enrolled in collegiate weight training classes found that expectancy beliefs and all three task values were significantly related to intention to engage in weight training after the conclusion of the academic course, which affirms the relationship between perceived value of an activity and activity engagement put forth by the model (Eccles et al., 1983). A third study that investigated 232 college students' self-reported physical activity levels and their expectancy-value beliefs about both physical education classes found positive relationships between all expectancy-value variables and higher physical activity levels, which suggests that the more students valued physical education courses and believed they would be successful in them, the more likely they were to engage in more physical activity overall (Vernadakis et al., 2014).

In addition to the three types of values, the model defines a fourth dimension of subjective task values, which is termed cost (Eccles et al., 1983). In contrast with the three values, cost may be understood to be the perceived drawbacks of undertaking a task or behavior (Eccles et al., 1983; Wigfield & Eccles, 2000). Costs may be financial, temporal, physical, or emotional in nature and may only detract from the overall value of a task (Eccles et al., 1983; Eccles & Harold, 1991). In the literature, barriers to physical activity among individuals with visual impairments have been presented as atheoretical (Jaarsma et al., 2014; Lee et al., 2014; Shaw et al., 2012). There is reason to suspect, however, that there exists a logical parallel between the barriers, which are defined as inhibitors of a behavior or activity, and expectancy-value theory's conceptualization of cost, which is understood to be drawbacks or negatives associated with a behavior or activity and undermine its value (Eccles et al., 1983; Eccles & Harold, 1991). A study by Chiang, Byrd, and Molin (2011) examining physical activity among children noted the substantial overlap of costs and barriers, though they noted that the conceptual breadth of barriers covered items outside of those included within the dimension of cost (e.g., lack of access). Similarly, in a qualitative inquiry of the expectancy-value beliefs of adults with visual impairments about physical activity, all participants responded to questions about cost or drawbacks of physical activity engagement with a variety of barriers ranging from lack of transportation to perceived social cost of potential negative interactions with sighted peers (Kirk & Haegele, in press).

To date, no study conducted among adults with visual impairments has considered the role of motivation to be active by measuring expectancy-value beliefs about physical activity. Although barriers to physical activity among adults with visual impairments have been investigated, only one prior inquiry has examined the relationship between barriers to physical activity and physical activity engagement (Shaw et al., 2012). While Shaw and colleagues did find a negative correlation between barriers and self-reported physical activity, no study has considered the role of barriers as somewhat analogous to the cost dimension presented within the expectancy-value theory (Eccles et al, 1983). Therefore, the purpose of this inquiry was to examine the relationship between barriers to physical activity, expectancy-value variables, and physical activity engagement among adults with visual impairments. Research questions include: (a) to what degree are barriers to physical activity related to the physical activity levels of adults with visual impairments, (b) to what degree are expectancy-value beliefs related to physical activity levels of adults with visual impairments, (c) to what degree are barriers to physical activity related to expectancy-value beliefs of adults with visual impairments?

Materials and Methods

Instruments

Four questionnaires were used in this study: (a) the barriers to physical activity for adults with visual impairment (BPAAVI), (b) the self- and task-perception questionnaire (STPQ), (c) the international physical activity questionnaire-short form (IPAQ-SF), and (d) a demographic questionnaire. Together, the four instruments totaled 44 items. All instruments and methods were reviewed and approved by the institutional review board (IRB) at the author's institution of employment prior to the commencement of data collection.

Barriers to Physical Activity for Adults with Visual Impairments (BPAAVI). Participants' perceived barriers to physical activity were measured using a newly-developed instrument, the BPAAVI. This 12-item scale was designed to measure the magnitude of barriers to physical activity using a five point Likert-type scale. More detailed information regarding the development and validation of the BPAAVI is presented in a separate study. Participants were asked to rate how much each barrier item had impacted their physical activity engagement ranging from one (i.e., "no impact") to five (i.e., "large impact"). Prior to use in this analysis, items of the BPAAVI were subject to two rounds of data reduction including exploratory factor analysis, principal component analysis, and confirmatory factor analysis. The exploratory factor analysis resulted in a four-factor model with Cronbach's alpha levels ranging from .72 to .86, which met the threshold for adequate internal consistency. The confirmatory factor analysis further reduced the data and loaded items onto a three-factor model. Factors included (a) accessibility factors (e.g., lack of accessible equipment, facilities, and programming), (b) personal factors (e.g., being too busy to be active, being frustrated with one's progress in physical activity, and discomfort associated with physical activity), and (c) transportation factors (e.g., lack of safe or reliable transportation to fitness facilities). Five items in the scale pertain to accessibility barriers, four items pertain to personal barriers, and three pertain to transportation barriers. Cronbach's alpha for the retained 12-item scale was .85, which exceeds the accepted standard for good internal consistency.

Self- and Task-Perception Questionnaire (STPQ). Participants' perceived expectancy beliefs and the three types of task values (i.e., intrinsic or interest, attainment or importance, and utility values) associated with participating in physical activity were measured using a modified version of Eccles and Wigfield's (1995) STPQ. This 12-item questionnaire utilizes a seven point Likert-type scale that asks participants to rate their perceptions of items related to task values and expectancy beliefs. For example, on the item "How important is engaging in regular physical activity and exercise to you?" respondents were asked to select the response ranging from one (i.e., "not important") to seven (i.e., "very important") that they felt best reflected their beliefs about the importance of physical activity and exercise. The scale is split into two categories: perceived task values items and ability/expectancy-related items. The ability/expectancy section is unidimensional and has five items designed to capture participants' ability beliefs and expectations for success with regard to physical activity and exercise. The perceived task values portion is further subcategorized into three dimensions by the types of values presented in the model (i.e., intrinsic or interest, attainment or importance, and utility). Two items address intrinsic and utility values, respectively, while three items pertain to attainment value or importance of physical activity and exercise. For all items, higher ratings indicated higher feelings of interest, importance, utility, and expectations of success.

While the STPQ was designed for use with children and adolescents in an academic setting, its modified version has been used successfully in other contexts, including physical activity for adult populations (Gao, 2008, 2009). In a study of university students' motivation toward weight training, Gao (2008) utilized a modified version of the STPQ. Results of a confirmatory factor analysis on the modified instrument indicated an acceptable model fit with Cronbach's alphas ranging from .79 to .81, which indicated that each subscale possessed acceptable internal reliability (Gao, 2008). A second study by Gao (2009) using a modified STPQ bolstered its reliability and indicated that the modified version of the STPQ is suitable for use with adult populations within the context of physical activity tasks. It is important to note that the present study is the first time that a version of STPQ has been used among a population of adults with visual impairments.

International Physical Activity Questionnaire-Short Form (IPAQ-SF). Physical activity levels were measured using the IPAQ-SF (Craig et al., 2003). This self-report questionnaire is a seven-day recall measure that asks participants to report how much time they spent engaging in various levels of physical activity during the previous week. Physical activity level options include walking, moderate physical activity, and vigorous physical activity. The instrument includes both planned physical activity, such as exercise or recreation activities, as well as unplanned physical activity, like physical activity undertaken as part of an individual's workday or for the purposes of transportation. Currently, IPAQ-SF is one of the most commonly used self-report physical activity inventories and has established acceptable reliability ($\rho = 0.76$) and concurrent validity ($\rho = 0.67$) among sighted adults (Craig et al., 2003). The instrument has been widely used in studies pertaining to the physical activity levels of adults with visual impairments (Haegele, Famelia, & Lee, 2017; Haegele et al., 2018; Haegele et al., 2016;

Marmeleira et al., 2014; Sadowska & Krzepota, 2015). Haegele et al. (2016) indicated that the IPAQ-SF had demonstrated "moderate and acceptable levels of criterion validity and user sensitivity for use with adults with visual impairments" (p. 6). Further, the instrument has showed moderate correlations with objective measures for this population (from $r = 0.38$ to $r = 0.57$) (Marmeleira et al., 2014; Sadowska & Krzepota, 2015).

Demographic questionnaire. Finally, a brief demographic questionnaire was included to gather data about participant characteristics. This instrument contained of six questions about participants' age, gender identity, racial or ethnic identity, visual impairment level, and the type of environment (i.e., rural, suburban, or urban) in which they resided. The final item contained two parts and first asked participants whether they experienced any disabilities in addition to their visual impairment, while the second open-ended prompt allowed participants to describe additional disabilities in as much detail as they wished to include.

Data Collection

Participants for this study were recruited in two ways. First, a call for participants was distributed to several online registries of individuals with visual impairments who had expressed interest in participating in research. In addition to online registries, the call for participants was distributed via social media pages for individuals with visual impairments. The call for participants included information about the purpose of the study, criteria for inclusion, and approximate time commitment for participation. Criteria for inclusion in the study included (a) being over the age of 17 but under the age of 66 years old at the time of data collection, (b) identifying as having a visual impairment, (c) having no other disabilities that might impact the ability to participate in physical activity, and (d) having access and ability to complete the questionnaires. The age range (18-65) was purposively selected because the focus of this study was working-age adults with visual impairments. Like their sighted peers, adults, children, and older adults (i.e., those 66 years or older) with visual impairments likely have different expectancy-value beliefs and experience different barriers to physical activity participation based on age.

The questionnaire was hosted on two accessible survey platforms to ensure that participants who use assistive technology, such as screen readers or text magnification, were able to complete all items. Accessibility was determined by sending a formatted sample of the questionnaire to a panel of experts on assistive technology, including individuals who themselves have visual impairments. Before they could access the questionnaire itself, potential participants were taken to a welcome statement that included the purpose of the study, the study protocol, and a consent statement. Potential participants were not able to proceed to the questionnaire itself without first consenting to participation by selecting the response box that stated that they read, understood, and agreed to the terms of the consent statement. Participants could discontinue participation at any time by leaving the questionnaire prior to completing all items. Though the majority of participants utilized online platforms to complete the questionnaire, participants who could not access the online questionnaire were given the option to (a) complete a text document (i.e., Microsoft Word) version of the questionnaire via email, or (b) complete the survey via telephone by having the researcher read the questions to the participant and enter their responses into the online questionnaire. In either instance, participants must have consented to participation prior to receiving an alternative version of the questionnaire. No participants elected to use the text document option, and three participants took the questionnaire by telephone. Only completed questionnaires were included in data analysis and results. All data collection procedures were reviewed and approved by the Institutional Review Board at the authors' university affiliation.

Participants

In total, 252 adults with visual impairments completed the questionnaires. Prior to data analysis, three participants who identified as having additional disabilities that impacted ambulation (i.e., being wheelchair users) were removed from the sample because of the inherent difficulty in ascertaining whether the relationships between variables were related to their visual impairment, to being wheelchair users, or to having multiple disabilities. Similarly, 35 participants who reported being over the age of 65 years at the time of data collection were removed from the sample because they were outside of the specified age range for the study. A final sample of 214 participants (149 women, 64 men, one other) were included in the analyses. Participants' mean age at the time of data collection was 43.14 years old (SD = 13.67). The majority of participants (n = 162; 75.7%) identified as White (non-Hispanic), while others identified as African American/Black (n = 9; 4.2%), Asian/Pacific Islander (n = 12; 5.6%), Hispanic/Latino (n = 20; 9.3%), and Native American (n = 1; .5%). Ten participants (4.7%) identified as members of another race or ethnic group not named above. Most participants (n = 112; 52.3%) reported having a visual acuity ranging from no light perception to minimal light perception but without the ability to recognize the shape of a hand from any distance or direction (i.e., B1; United States Association of Blind Athletes, 2013). Forty-one participants (19.2%) reported having a range of vision including the ability to recognize the shape of a hand using their better eye up to a visual acuity of up to 20/600 or a visual field of 5 degrees or less in their better eye with best possible correction (i.e., B2), 52 participants (24.3%) identified as having vision that ranged from 20/600 to 20/200 or a visual field of greater than 5 degrees but less than

20 degrees in the better eye with the best correction (i.e., B3). The remaining 4.2% of participants (*n* =9) reported having "low vision" which means that while they did not meet the criteria for legal blindness, they still had a visual impairment under the definition provided by the CDC (i.e., B4). Most participants reported residing in either urban (*n* = 90; 42.1%) or suburban (*n* = 96; 44.9%) settings, while 28 participants (13.1%) reported living in a rural area with fewer than 19,999 residents.

Data Analysis

Demographic data were analyzed descriptively via frequencies and measures of central tendency and dispersion. Mean scores for each factor of the BPAAVI (i.e., accessibility, personal, and transportation) and the STPQ (i.e., intrinsic or interest value, attainment value, utility value, and expectancy beliefs) were then calculated. Physical activity scores were calculated by converting IPAQ-SF data to metabolic equivalent minutes-per-week (MET-min/week) using a standardized protocol prescribed by the questionnaire developers to compile data across intensity levels (i.e., vigorous, moderate, and walking), durations, and number of days in which each type of activity was reported (Craig et al., 2003). In keeping with the protocol, each minute of light activity/walking was valued at 3.3 METs, moderate-physical activity minutes were worth 4 METs each, and vigorous physical activities were calculated at 8 METs per minute. In the present study, physical activity engagement is represented by total MET-min/week.

Because items in the STPQ were adapted slightly to address physical activity, a confirmatory factor analysis based on covariance structures was performed to ensure model goodness-of-fit for use in the context of the current study. Evaluation of model fit utilized the following fit indices: the χ^2 model test; Bentler's (1990) revised normed comparative fit index

(CFI), wherein a score greater than .95 is considered excellent, the root mean square error of approximation (RMSEA), in which scores between .05–.10 are acceptable, and standardized root mean square residual (SRMR), in which scores less than .09 are acceptable. Comparisons of model fit were made using $|\Delta CFI|$ and $\Delta\ \chi^2$ with a robust estimation approach (Cheung & Rensvold, 2002).

Finally, potential relationships between variables were examined inferentially. A Pearson product moment correlation was used to examine relationships between age, mean scores for each factor of the BPAAVI (i.e., accessibility barriers, personal barriers, and transportation barriers) and the STPQ (i.e., interest or intrinsic value, attainment value, utility value, and expectancy beliefs), and MET-min/week. To explore potential impacts of expectancy-value scores, barriers to physical activity scores, and demographic variables on MET-min/week, a multiple regression using MET-min/week as a dependent variable was conducted. Each factor of the BPAAVI, each factor of the STPQ, age, gender, and visual impairment level were entered as independent variables.

Results

Participants reported an average of 1568.55 MET-min/week (*SD* = 1647.78). Mean reported accessibility barrier scores were 2.56 (*SD* = 1.18), personal barrier scores were 2.44 (*SD* = 1.01), and transportation barrier scores were 2.22 (*SD* = .95). Participants reported an average interest or intrinsic value score of 5.02 (*SD* = 1.69), an average attainment value score of 5.23 (*SD* = 1.39), and a mean utility value score of 6.00 (*SD* = 1.27). The mean reported score for the expectancy beliefs factor was 4.12 (*SD* = 1.45). Results of the Pearson product moment correlation indicated that there was a significant negative relationship between MET-min/week and mean scores across each of the barrier factors (accessibility barriers $r = -.19$, $p < .01$;

personal barriers $r = -.22$, $p < .01$; transportation barriers $r = -.19$, $p < .01$). Conversely, MET-min/week were significantly positively associated with each of the expectancy-value factors (interest or intrinsic value $r = .36$, $p < .001$; attainment value $r = .25$, $p < .001$; utility value $r = .26$, $p < .001$; expectancy beliefs $r = .43$, $p < .001$). All BPAAVI factors were significantly positively correlated with each other, and STPQ factors had significant positive relationships. Participant age was not significantly correlated with any other variable. See Table 1 for correlations between all variables.

Next, a confirmatory factor analysis was undertaken to assess the STPQ model, and to investigate any alternative models that may be statistically more viable than the earlier scale. Indices used to assess goodness-of-fit included: (a) the χ^2 model test, (b) Bentler's (1990) revised normed comparative fit index (CFI; > .95 great, > .90 acceptable), (c) the root mean square error of approximation (RMSEA; < .05 great, .05–.10 acceptable, > .10 poor), and (d) standardized root mean square residual (SRMR; < .09 acceptable). These indices reflect model fit (χ^2 test), absolute fit (SRMR, RMSEA), and incremental fit (CFI), and reflect accepted standards for confirmatory factor analyses (Byrne, 2010; Hair, Black, Babin, & Anderson, 2010; Hooper, Coughlan, & Mullen, 2008; Kline, 2011; Thompson, 2004). Results of the confirmatory factor analysis showed adequate data-model fit (see Table 2). Model A in Table 2 reflects all 12 items included in the initial questionnaire. However, deletion of one item under the attainment value factor (e5) resulted in significantly improvement in CFI and χ^2 ($|\Delta CFI| = .040$; $\Delta \chi^2 = 56.164$, $p < .05$). This improvement is represented by Model B in Table 2. Loadings for the final 11-items retained in the model are represented in Figure 2.

A multiple regression analysis was used to examine how much BPAAVI factors, STPQ factors, age, gender identity, and visual impairment level might predict participants' MET-min/week. As shown in Table 3, the results of the regression analysis indicate that 20.30% of variance in MET-min/week was explained by the model ($F_{10, 198} = 6.30$, $p < .001$). The effect size ($f^2 = .25$) exceeds the standard for a medium effect size ($f^2 = .15$), per Cohen (1988). Two variables were significant positive predictors for total weekly MET minutes, mean interest or intrinsic value ($\beta = .26$, $p < .01$) and mean expectancy beliefs ($\beta = .33$, $p < .001$), while controlling for other factors.

Discussion

The purpose of this inquiry was to examine the relationship between barriers to physical activity, expectancy-value variables, and physical activity engagement among adults with visual impairments. This study contributed to the body of scholarly work in adapted physical activity, first by measuring the relationship between barriers to physical activity and physical activity engagement, and second by examining motivational beliefs about physical activity using Eccles and colleagues' (e.g., 1983) expectancy-value model. While barriers to physical activity among adults with visual impairments have been investigated in the past, most prior inquiries have not considered the relationships between reported barriers and physical activity engagement (Jaarsma et al., 2014; Lee et al., 2014). In the present study, negative significant relationships were found between accessibility barriers, personal barriers, transportation barriers, and physical activity engagement. That is, higher mean scores on each barrier category were correlated with lower reported MET minutes/week. This relationship is partially supported by results of one that did examine constraints to physical activity alongside physical activity engagement (Shaw et al., 2012). This study found a significant negative correlation between intrapersonal barriers (i.e., barriers related to perceptions about the self) to physical activity and self-reported physical activity engagement among adults with visual impairments. While the barrier factor categories differ somewhat between this earlier study and the current inquiry, the intrapersonal barriers factor presented in Shaw et al. (2012) contains similar items to the personal barriers factor contained herein. For example, both categories include items about perceived skills (e.g. “I am frustrated with my lack of improvement at physical activity”) and self-beliefs about physical activity (e.g. “I don’t enjoy being physically active”). While the current inquiry found that accessibility and transportation factors were negatively related to physical activity engagement, Shaw et al. (2012) did not find a relationship between similar factors and physical activity in their study. Reasons for this difference are unclear, but may be related to differences between scale items or population differences, as the previous study was conducted exclusively among Canadians with visual impairments who may experience fewer access and transportation-related barriers than participants in the present study, which did not specify country of origin as part of its criteria for participation, though recruitment was based in the United States. Further investigation of perceived accessibility and transportation barriers and physical activity engagement is needed to better understand this relationship.

Correlation results of the current study showed significant positive relationships between each of the expectancy-value variables (i.e., attainment value, intrinsic or interest value, utility value, and expectancy beliefs) and physical activity engagement. This finding is consistent with the expectancy-value model, wherein task values and expectancy beliefs are each posited to be positively related to a volitional behavior or activity, in this case physical activity (Eccles et al., 1983; Wigfield & Cambria, 2010). Further, this result is in alignment with prior studies of other populations within the broad context of physical activity and physical education (Chiang et al., 2011; Gao, 2008; Vernadakis, Kouli, Tsitskari, Gioftsidou, & Antoniou, 2014). For example, when examining motivation toward weightlifting among college students enrolled in a fitness course, Gao (2008) found that task values were significant predictors of college students' intentions to continue participation in weight training activities, while expectancy beliefs significantly predicted students' performances on weight lifting skill tests.

Interestingly, in the current study, personal barriers were significantly negatively correlated with all expectancy-value variables, which suggests that individuals who hold inhibitive self-beliefs about their physical activity engagement (e.g., frustration with their progress, dislike of physical activity in general) are also less likely to value physical activity or believe that they are likely to succeed when being active. This finding is in keeping with previous studies in which personal factors have been among the most frequent barriers reported, particularly among inactive participants (Jaarsma et al., 2014; Lee et al., 2012). While no prior studies have examined the relationship between barriers to physical activity and expectancy-value beliefs, the importance of accessibility barriers has been noted. For example, Shaw et al. (2012) found that environmental constraints (i.e., accessibility barriers) were rated to be the most impactful of barrier categories on average, as reported by individuals with visual impairments. Accessibility barriers were also negatively related to intrinsic or interest value, utility value, and expectancy-beliefs, which suggests that individuals who believe that facilities and activities are not accessible to them may also feel that physical activity is not enjoyable or useful to them and that they are unlikely to succeed when engaging in physical activity. Overall, the negative relationships between barriers factors and expectancy-value beliefs suggests that among adults with visual impairments, barriers to physical activity may fill a similar conceptual role to costs within the expectancy-value framework. Additional inquiries comparing the impact of traditional costs contained within the expectancy-value model and those included as barriers to physical activity could further elucidate their operative similarities and differences within the context of physical activity engagement and expectancy-value beliefs.

Results of the regression analysis indicated that of all the variables considered, only expectancy beliefs and intrinsic or interest value were significant predictors of physical activity engagement. Unsurprisingly, expectancy beliefs, including expectations for success and feelings of competence, have been shown to be predictive of activity engagement in a variety of contexts, including physical activity (Cox & Whaley, 2004; Eccles & Harold, 1991). Present findings about task values are somewhat supported by earlier studies by Gao (2008) and Cox and Whaley (2004) that found a predictive relationship between overall task values and engagement in physical activity and sport. Interestingly, utility and attainment value did not significantly predict physical activity in the present study, which is in keeping with earlier findings in which intrinsic or interest value was more predictive of one's present engagement in a specified activity while attainment value was more closely linked to intention to engage in an activity in the future (Eccles & Wigfield, 1995; Wigfield et al., 1997). Because prior inquiries among populations without disabilities have found a predictive relationship between barriers and physical activity engagement (Reicher, Barros, Domingues, & Hallal, 2007; Salmon, Owen, Crawford, Bauman, & Sallis, 2003), the absence of barrier factors among significant predictors of physical activity engagement was a surprising result. However, it is possible that the while the perception of barriers may have inhibited planned or structured physical activity such as exercise or sport among participants, it did not impact less structured physical activity such as walking for transportation, which has been reported as the most common source of physical activity for individuals with visual impairments (Wrzesinska, Lipert, Urzedowicz, & Pawlicki, 2018). Future inquiries could investigate which barriers are perceived to be impactful on various types of physical activity engagement such as walking for transportation, walking for exercise, exercising in a fitness facility, and organized recreational sport.

There are several limitations presented in this study. The use of a self-report instrument for physical activity engagement, rather than a method of objective measurement such as accelerometer or fitness tracker could be considered a limitation because of concerns about over-reporting errors. A self-report approach was used because of the practical issues of cost, time, and feasibility associated with issuing accelerometers or fitness trackers to the entire participant sample, many of whom were geographically removed from the author's research institution. However, while reporting errors are more likely with self-report methods, there is continued support for their use as valid instruments for research (Haskell, 2012). Second, the use of online questionnaires as a primary source of data could be considered a limitation because it may have excluded participants with visual impairments who are uncomfortable or unable to access them. However, the call for participants presented alternative avenues for participation in the study including telephone and word processor platforms, which few participants elected to pursue. Sample characteristics could also be considered a limitation of the study. Participants in this study largely identified as White, female, urban or suburbanites with minimal to no vision (i.e., B1), while individuals of other races or ethnic groups, males, individuals with low vision or legal blindness (i.e., B4, B3), and those who resided in rural areas were relatively underrepresented in the sample. As such, readers should consider population characteristics presented herein when considering the generalizability to the larger population of adults with visual impairments.

In summary, the purpose of this study was to examine the relationship between barriers to physical activity, expectancy-value variables, and physical activity participation among adults with visual impairments. To the author's knowledge, it is the first paper to examine these associations among this population. In total, barrier variables, expectancy-value variables, age, visual impairment level, and gender identity explained 20.30% of the total variance in physical activity engagement, as measured by total MET minutes/week, with a medium effect size (f^2 = .25). Holding all other variables constant, intrinsic or interest value and expectancy beliefs—two variables presented within the expectancy-value model of motivation—emerged as significant predictors of physical activity engagement. Additional study is needed to further understand the role of barriers to physical activity, attainment value, and utility value on the physical activity engagement of this group. However, this finding offers support for the usefulness of expectancy-value theory within the context of physical activity for individuals with visual impairments.

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Table 7. Mean, standard deviation, skewness, kurtosis, and correlations for variables.

	Mean (*SD*)	Sk	K	1	2	3	4	5	6	7	8	9
1. Mean Accessibility Barrier	2.56 (1.18)	0.34	-1.04	-								
2. Mean Personal Barrier	2.44 (1.01)	0.42	-0.74	.44**	-							
3. Mean Transportation Barrier	2.22 (.96)	0.59	-0.39	.55**	.31**	-						
4. Mean Intrisic/Interest Value	5.03 (1.69)	-0.76	-0.29	-19**	-.52**	-0.04	-					
5. Mean Attainment Value	5.21 (1.41)	-0.78	0.45	-0.12	-.32**	-0.09	61**	-				
6. Mean Utility Value	6.01 (1.26)	-1.49	2.27	-.14*	-.22**	-0.08	.45**	.62**	-			
7. Mean Expectancy Beliefs	4.21 (1.44)	-0.15	-0.66	-.34**	-.44**	-.23**	.56**	.56**	.46**	-		
8. METmin/week	1568.55 (1647.78)	-0.04	3.41	-.19**	-.22**	-.19**	.36**	.25**	.26**	.43**	-	
9. Age	43.14 (1367)	-0.04	-1.18	.08	-.12	.07	-.01	-.01	.05	.10	.01	-

Note. SD = standard deviation; *Sk* = skewness; *K* = kurtosis.; METmin/week = metabolic equivalent minutes-per-week. * $p < .05$; ** $p < .01$

Table 8. CFA models for STPQ.

CFA Model	Goodness-of-Fit indices					Model comparison	
	YB X^2	df	CFI	RMSEA (90% CI)	SRMR	ΔCFI	ΔX^2
A	139.806	50	.945	.092 (.074, .110)	.062	-	-
B	83.642	40	.985	.072 (.050, .093)	.042	.040	56.164**

Note. CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; 90% CI = 90% confidence interval; SRMR = Standardized Root Mean-Square Residual. ***p* < .001

Table 9. Multiple regression results.

Predictors	*DV: Total METmin/week* (R^2 = 20.30%, F10, 198 = 6.30, p <.001)				
	B	*SE*	*β*	*t*	*P*
Intercept	-1416.31	901.11		-1.57	.12
Age	-1.63	7.79	-.01	-.21	.83
Gender Identity	309.98	221.83	.09	1.40	.16
Visual Impairment Level	38.09	221.83	.09	.34	.74
Mean Accessibility Barrier	17.14	111.80	.01	.15	.88
Mean Personal Barrier	117.01	136.37	.07	.86	.39
Mean Transportation Barrier	-222.99	133.09	-.13	-1.68	.10
Mean Intrinsic/Interest Value	255.02	90.97	.26	2.80	.01**
Mean Attainment Value	-188.66	114.34	-.16	-1.65	.10
Mean Utility Value	153.94	108.68	.12	1.42	.16
Mean Expectancy Beliefs	370.63	97.07	.33	3.82	.00**

Note. SE = standard error. * p <.001

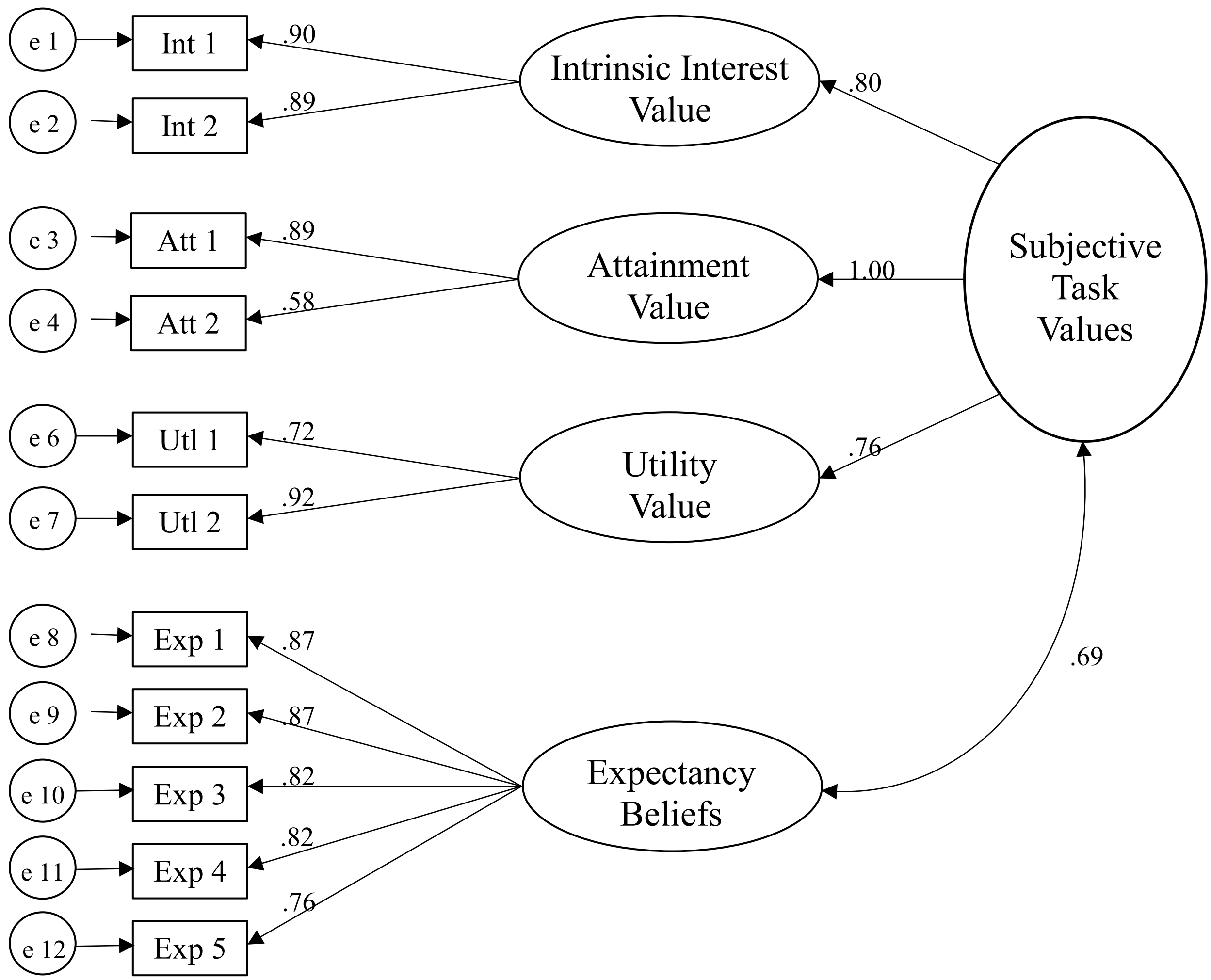

Figure 2. Final 11-item STPQ with standard estimates.

CHAPTER V: SUMMARY & CONCLUSIONS

The role of physical activity in overall health has been well-researched (CDC, 2014; Warburton, Nicol, & Bredin, 2006). Despite this, adults with visual impairments tend not to engage in sufficient physical activity for health promotion (Carroll et al., 2014; Holbrook et al., 2009; Holbrook et al., 2013; Marmeleira et al., 2014; Starkoff et al., 2017). Perceived barriers to physical activity may be related to the physical activity engagement of adults with visual impairments (Jaarsma et al., 2014; Shaw et al., 2012). Less is known, however, about the relationship between motivational beliefs and physical activity engagement among this population.

The purpose of the first study was to develop and validate a brief scale designed to measure the magnitude of barriers to physical activity for use among adults with visual impairments. The development and validation of the Barriers to Physical Activity for Adults with Visual Impairments scale (BPAAVI) was comprised of several methodological phases including item development, data collection one, exploratory factor analysis, data collection two, and confirmatory factor analysis. The item development phase resulted in a 30-item initial instrument. Following exploratory factor analysis, the scale was reduced to 19 items that loaded on four factors (i.e., accessibility barriers, personal barriers, safety barriers, and travel barriers). Data reduction from the confirmatory factor analysis removed an additional seven items and one factor, resulting in 12 items on a three-factor model. The confirmatory factor analysis for the final scale showed acceptable model fit, which indicates that the BPAAVI is a valid and reliable instrument to measure the magnitude of barriers to physical activity for adults with visual impairments.

The findings of the first study have two main implications. First, the validation of the BPAAVI provides insight into the factorial makeup of relevant items that present barriers to physical activity for individuals with visual impairments. Prior studies concerning barriers to physical activity have utilized largely descriptive methodologies to gather information about the perceived barriers to physical activity and sport among adults with visual impairments and did not make inferential associations between said barriers and actual physical activity engagement (Jaarsma et al., 2014; Lee et al., 2014). The present scale may be used to examine relationships between perceived barriers to physical activity and actual physical activity engagement in order to better understand the role of barriers for this population. As the first instrument validated for adults with visual impairments that measures the magnitude of potential barriers, the BPAAVI may be used to address the concept of perceived impact of a barrier by answering the question of “how much” rather than “how often” the respondent perceives a barrier (Law et al., 2007).

Second, because of the relatively small number of factors and items in the final instrument, this scale offers greater utility for use alongside other instruments or questionnaires with lessened risk of participant fatigue when compared to other instruments that contain more items. Though there is no universal threshold for number of items in an instrument, there is evidence to suggest that self-guided surveys yield greater responses when they take less time to complete (Choi & Pak, 2005; Hartge & Cahill, 1998). Therefore, this study and the BPAAVI present a meaningful addition to the body of knowledge concerning the magnitude of barriers to physical activity experienced by adults with visual impairments.

The purpose of the second study was to examine the relationship between barriers to physical activity, expectancy-value variables, and physical activity engagement among adults with visual impairments. This inquiry utilized a correlational design in which participants with visual impairments completed an online survey composed of four instruments that measured the aforementioned variables. Significant positive relationships were found between expectancy-value variables and physical activity engagement, while physical activity was negatively correlated with all barriers factors. Results of a multiple linear regression found that taken together; age, gender identity, visual impairment level, barrier factors, and expectancy-value factors explained a 20.30% of variance of physical activity engagement. Intrinsic or interest value and expectancy beliefs each emerged as significant predictors of physical activity when all other variables were held constant.

This study contributed to the body of scholarly work in adapted physical activity, first by measuring the relationship between barriers to physical activity and physical activity engagement, and second by examining motivational beliefs about physical activity using the expectancy-value model. The positive relationships found between expectancy-value variables and physical activity engagement is consistent with the expectancy-value model, wherein task values and expectancy beliefs are each posited to be positively related to a volitional behavior, in this case physical activity. The negative relationships between barriers factors and expectancy-value beliefs suggests that among adults with visual impairments, barriers to physical activity may fill a similar conceptual role to costs within the expectancy-value framework.

Additional inquiries comparing the impact of traditional costs contained within the expectancy-value model and those included as barriers to physical activity could further elucidate their operative similarities and differences within the context of physical activity engagement and expectancy-value beliefs. Interestingly, utility and attainment value did not significantly predict physical activity in the present study, which is in keeping with earlier findings in which intrinsic or interest value was more predictive of one’s present engagement in a specified activity while attainment value was more closely linked to intention to engage in an activity in the future.

Because prior inquiries among populations without disabilities have found a predictive relationship between barriers and physical activity (Reicher, Barros, Domingues, & Hallal, 2007; Salmon, Owen, Crawford, Bauman, & Sallis, 2003), the absence of barrier factors among significant predictors of physical activity engagement was a surprising result. However, it is possible that while the perception of barriers may have inhibited planned or structured physical activity such as exercise or sport among participants, it did not impact less structured physical activity such as walking for transportation, which has been reported as the most common source of physical activity for individuals with visual impairments (Wrzesinska, Lipert, Urzedowicz, & Pawlicki, 2018).

To the author's knowledge, the first study developed and validated the first instrument designed to measure the magnitude of barriers perceived by adults with visual impairments. This result contributes to the body of literature by creating a scale that may be used to measure barriers to physical activity in isolation or alongside various other scales within the context of adapted physical activity research. The second study also presents a unique contribution to the field of adapted physical activity. One of only a few inquiries to examine motivation for physical activity among individuals with visual impairments, the significant relationships between expectancy-value beliefs and physical activity engagement support the usefulness of the model within the field of adapted physical activity research. However, additional research is needed to further understand the role of barriers to physical activity, attainment value, and utility value on the physical activity engagement of this group.

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APPENDICES

BARRIERS TO PHYSICAL ACTIVITY FOR ADULTS WITH VISUAL IMPAIRMENT SCALE (PRELIMINARY)

How much have the following impacted your physical activity engagement?	No Impact 1	2	3	4	Large Impact 5
Environmental Barriers					
I don't have access to reliable transportation	1	2	3	4	5
There are no fitness facilities near me	1	2	3	4	5
There are no adapted activities near me	1	2	3	4	5
Facilities near me are not accessible	1	2	3	4	5
Equipment available to me is not accessible	1	2	3	4	5
The locker rooms are not accessible	1	2	3	4	5
Fitness or physical activity staff is not trained	1	2	3	4	5
There are no programs to help me learn to exercise	1	2	3	4	5
It is too expensive to be physically active	1	2	3	4	5
The weather is unsuitable for being physically active	1	2	3	4	5
Personal Barriers					
My visual impairment	1	2	3	4	5
My lack of knowledgeable about activities	1	2	3	4	5
My lack of discipline when maintaining physical activity	1	2	3	4	5
I don't enjoy being physically active	1	2	3	4	5
I am in poor health	1	2	3	4	5
I am too old to be physically active	1	2	3	4	5
I become fatigued or uncomfortable when being active	1	2	3	4	5
I lack confidence when pursuing physical activities	1	2	3	4	5
I am too tired from daily activities to be physically active	1	2	3	4	5
I am frustrated with my lack of improvement at physical activity	1	2	3	4	5
I am too busy with other activities to be physically active	1	2	3	4	5
Social Barriers					
My friends or family don't support me in physical activity	1	2	3	4	5
I don't have anyone to be physically active with	1	2	3	4	5
I am not accepted in physical activity because of my visual impairment	1	2	3	4	5
I am dependent on others to be physically active	1	2	3	4	5
I am self-consciousness about being physically active in front of others	1	2	3	4	5
I have had negative interactions with others in when being active	1	2	3	4	5
Safety Barriers					
I'm afraid I'll be injured	1	2	3	4	5
I'm afraid I'll get lost	1	2	3	4	5
I feel that my transportation options to access facilities are unsafe	1	2	3	4	5

19-ITEM BARRIERS TO PHYSICAL ACTIVITY FOR ADULTS WITH VISUAL IMPAIRMENT SCALE (DATA COLLECTION 2)

How much have the following impacted your physical activity engagement?	No Impact 1	2	3	4	Large Impact 5
Environmental Barriers					
There are no adapted activities near me	1	2	3	4	5
Facilities near me are not accessible	1	2	3	4	5
Equipment available to me is not accessible	1	2	3	4	5
The locker rooms are not accessible	1	2	3	4	5
Fitness or physical activity staff is not trained	1	2	3	4	5
There are no programs to help me learn to exercise	1	2	3	4	5
Personal Barriers					
My lack of discipline when maintaining physical activity	1	2	3	4	5
I don’t enjoy being physically active	1	2	3	4	5
I become fatigued or uncomfortable when being active	1	2	3	4	5
I am too tired from daily activities to be physically active	1	2	3	4	5
I am frustrated with my lack of improvement at physical activity	1	2	3	4	5
I am too busy with other activities to be physically active	1	2	3	4	5
Safety Barriers					
I’m afraid I’ll be injured	1	2	3	4	5
I’m afraid I’ll get lost	1	2	3	4	5
I am in poor health	1	2	3	4	5
I am too old to be physically active	1	2	3	4	5
Transportation barriers					
I don’t have access to reliable transportation	1	2	3	4	5
There are no fitness facilities near me	1	2	3	4	5
I feel that my transportation options to access facilities are unsafe	1	2	3	4	5

12-ITEM BARRIERS TO PHYSICAL ACTIVITY FOR ADULTS WITH VISUAL IMPAIRMENT SCALE (FINAL VERSION)

How much have the following impacted your physical activity engagement?	No Impact 1	2	3	4	Large Impact 5
Environmental Barriers					
Facilities near me are not accessible	1	2	3	4	5
Equipment available to me is not accessible	1	2	3	4	5
The locker rooms are not accessible	1	2	3	4	5
Fitness or physical activity staff is not trained	1	2	3	4	5
There are no programs to help me learn to exercise	1	2	3	4	5
Personal Barriers					
My lack of discipline when maintaining physical activity	1	2	3	4	5
I don’t enjoy being physically active	1	2	3	4	5
I am frustrated with my lack of improvement at physical activity	1	2	3	4	5
I am too busy with other activities to be physically active	1	2	3	4	5
Transportation barriers					
I don’t have access to reliable transportation	1	2	3	4	5
There are no fitness facilities near me	1	2	3	4	5
I feel that my transportation options to access facilities are unsafe	1	2	3	4	5

SELF- AND TASK- PERCEPTION QUESTIONNAIRE (MODIFIED)

Please rate the following items as you believe they apply to you.

Item	Rating					
In general, I find participating in physical activity	Very boring 1	2	3	4	5	6	Very interesting 7
How much do you like participating in physical activity?	Not very much 1	2	3	4	5	6	Very much 7
Is the amount of effort it will take to do well in physical activity or exercise worthwhile to you?	Not at all important 1	2	3	4	5	6	Very important 7
I feel that, to me, being good at the exercises and physical activities I participate in is	Not at all important 1	2	3	4	5	6	Very important 7
How important is it to you to be better than your peers at the physical activities you participate in?	Not at all important 1	2	3	4	5	6	Very important 7
How useful is participating in physical activity or exercise for your future health and well-being?	Not very useful 1	2	3	4	5	6	Very useful 7
How useful is participating in physical activity or exercise in your daily life?	Not at all useful 1	2	3	4	5	6	Very useful 7
Compared to your peers, how well do you think you will do at meeting physical activity guidelines this year?	Much worse than others 1	2	3	4	5	6	Much better than others 7
How well do you think you will do at meeting physical activity guidelines this year?	Very poorly 1	2	3	4	5	6	Very Well 7
How proficient are you at physical activity and exercise?	Not at all proficient 1	2	3	4	5	6	Very proficient 7
Compared to your peers, how proficient do you think you are at physical activity and exercise?	The least proficient 1	2	3	4	5	6	The most proficient 7
How successful have you been at physical activity and exercise this year?	Not successful 1	2	3	4	5	6	Very successful 7

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE-SHORT FORM

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (August 2002)

SHORT LAST 7 DAYS SELF-ADMINISTERED FORMAT

FOR USE WITH YOUNG AND MIDDLE-AGED ADULTS (15-69 years)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health–related physical activity.

Background on IPAQ
The development of an international measure for physical activity commenced in Geneva in 1998 and was followed by extensive reliability and validity testing undertaken across 12 countries (14 sites) during 2000. The final results suggest that these measures have acceptable measurement properties for use in many settings and in different languages, and are suitable for national population-based prevalence studies of participation in physical activity.

Using IPAQ
Use of the IPAQ instruments for monitoring and research purposes is encouraged. It is recommended that no changes be made to the order or wording of the questions as this will affect the psychometric properties of the instruments.

Translation from English and Cultural Adaptation
Translation from English is supported to facilitate worldwide use of IPAQ. Information on the availability of IPAQ in different languages can be obtained at www.ipaq.ki.se. If a new translation is undertaken we highly recommend using the prescribed back translation methods available on the IPAQ website. If possible please consider making your translated version of IPAQ available to others by contributing it to the IPAQ website. Further details on translation and cultural adaptation can be downloaded from the website.

Further Developments of IPAQ
International collaboration on IPAQ is on-going and an ***International Physical Activity Prevalence Study*** is in progress. For further information see the IPAQ website.

More Information
More detailed information on the IPAQ process and the research methods used in the development of IPAQ instruments is available at www.ipaq.ki.se and Booth, M.L. (2000). *Assessment of Physical Activity: An International Perspective*. Research Quarterly for Exercise and Sport, 71 (2): s114-20. Other scientific publications and presentations on the use of IPAQ are summarized on the website.

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities ➡ ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities ➡ ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

DEMOGRAPHIC QUESTIONNAIRE

Demographic Questionnaire	
1	How old are you? ____________Years of age
2	Which of the following best reflects your gender identity? a) Female b) Male c) Other
3	Which of the following best describes your current level of vision? a) No light perception in either eye up to light perception, but an inability to recognize the shape of a hand at any distance or in any direction (B1) b) The ability to recognize the shape of a hand up to visual acuity of 20/600 and/or a visual field of less than 5 degrees in the best eye with the best practical eye correction. (B2) c) Visual acuity above 20/600 and up to visual acuity of 20/200 and/or a visual field of less than 20 degrees and more than 5 degrees in the best eye with the best practical eye correction. (B3) d) Visual acuity above 20/200 and up to visual acuity of 20/70 and a visual field larger than 20 degrees in the best eye with the best practical eye correction. (B4)
4	Which of the following best describes your race or ethnic background? a) African American/ Black b) Asian/ Pacific Islander c) Hispanic/ Latino d) Native American e) White (Non-Hispanic) f) Other
5	Which of the following best describes the area where you live? a) Urban (i.e., densely populated area with at least 100,000 residents) b) Suburban (i.e., moderately populated area, between 20,000 and 99, 999 residents) c) Rural (i.e., sparsely populated area, fewer than 19,999 residents)
6	In addition to your visual impairment, do you have any other disabilities? a) No b) Yes If yes, please note any additional disabilities you experience

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Lieberman, L.J., Kirk, T.N., & Haegele, J.A. (2018). Physical Education and Transition Planning Experiences Relating to Recreation among Adults Who Are Deafblind: A Recall Analysis. *Journal of Visual Impairment & Blindness*, *112*(1), 73-86.