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Insight

Research and Practice in Visual Impairment and Blindness

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AER Association for Education and Rehabilitation of the Blind and Visually Impaired

AER

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Insight:
Research and Practice in Visual Impairment and Blindness

A quarterly journal in the field of education and rehabilitation of persons of all ages with low vision or blindness

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Cover Photo: Top: Photo by Louis “Eduardo” Cisneros, a 9th-grade student participating in a nature photography exercise directed by Lori Blake; courtesy of The Governor Morehead School for the Blind, Raleigh, NC. Bottom: 2011 United States Association of Blind Athletes (USABA) National Goalball Championships; photo by Amanda Tepfer.

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Special Issue: Recreation, Leisure, Sport, and Play

Special Issue: Recreation, Leisure, Sport, and Play

This issue addresses recreation, leisure, sport, and play—topics that have been difficult to research in the United States. With increasing inclusion of children with visual impairments in local schools, research with large numbers of children with visual impairments related to physical activity, sport, and recreation has been more difficult because young people with visual impairments or blindness are placed at a distance from each other.

Due to the fact that individuals with visual impairments have been shown to have low levels of physical activity, motor skills, and recreational opportunities, it is imperative that the process of conducting descriptive research as well as relevant intervention studies is focused and ongoing. We must collect data in real life settings and gain insight from individuals who are blind or visually impaired, teachers, parents, and paraeducators. We must learn about the current status of physical activity, motor skills, recreation, play, and leisure. We must also continue to gather and consider intervention data, which can be a key component of improving the lives of individuals with visual impairments.

About This Issue

I am pleased to introduce this special theme issue of *Insight* as a contribution to the evidence base related to supporting children with visual impairments in recreation, leisure, sport, and play. We received numerous submissions from all over the world for this issue. It was exciting to see the number of people who are now working in this area and providing some amazing opportunities for individuals with visual impairments.

The first article by Bowerman, Davis, Ford, and Nichols is an analysis of the sport of goalball. The authors reviewed the three parts of a throw: (1) preparation, (2) wind-up, and (3) follow through, and determined how each action affected ball velocity and accuracy in a game situation. Goalball is attracting more players each year and this is a wonderful contribution to what we know about this dynamic sport.

Exergames such as the Nintendo Wii are becoming very popular among people of all ages for recreation, fitness, socialization, and play. The second article in this theme issue is by Morelli, Folmer, Foley, and Lieberman and presents VI Fit, an open source exergaming platform dedicated to developing exergames for individuals with visual impairments. Three different exergames were created to encourage physical activity without requiring a video display: *VI Tennis*, *VI Bowling*, and *Pet-N-Punch*. The energy expenditure was measured and the results indicate the very important contribution this kind of research can make to our field.

The third article by Boffoli, Foley, Gasperetti, Yang, and Lieberman relates to the enjoyment level on three different exergames with youth with visual impairments ages 9 to 16. Games played were Dance Dance Revolution Extreme 2 (DDR), EyeToy Kinetic, and Wii Boxing. After each game participants filled out the Physical Activity Enjoyment Scale. The participants enjoyed playing these games. These findings suggest that youth with visual impairments can enjoy being physically active through use of the exergames. The increase in participation in exergames can improve socialization, physical activity, and quality of life.

The fourth article is by Benton and describes an outdoor multisensory trail. Benton describes a guided sensory forest experience and the step-by-step process to set up such an experience. The author also explains how the forest curriculum corresponded with the state core curriculum content standards. Making the outdoor experience accessible to people with visual impairments is something that is needed everywhere and this article permits others to emulate Benton's approach, providing such an experience for their own clients or students.

The fifth article is by Blake and shares how a teacher used photography to help students understand the world around them. This assignment used orientation and mobility, nature, photography, writing, and socialization all in one assignment. The culminating project even won the team of students third prize in a national contest!

Our sixth article is a book review by Holbrook about the book *Sites Unseen: Traveling the World Without Sight*. This book is a travel guide written from the viewpoint of an experienced traveler with a visual impairment. The unique features of the book focus on planning, packing, modes of transportation, safety, using a GPS, and overcoming barriers during travel. Travel is a wonderful use of recreation and leisure time and can be very beneficial for all individuals with visual impairments. It is made most enjoyable with some careful planning.

This theme issue is made possible through contributions from university professors, teachers, and specialists. The collective experiences and research findings of these contributors give us a better perspective on this very important area in our field. My hope is that this collection (and other articles on the subject to be published in future issues) will support our field and help inspire even more writing about physical activity, sport, recreation, and play. Thus, in the future we will benefit from an increased interest in improving the participation and involvement of people who are blind, visually impaired, or deaf-blind in all kinds of healthful physical activity, leisure, sport, and play.

I would like to thank *Insight* Editor-in-Chief, Dr. Deborah Gold, for inviting me to serve as the guest editor of this special theme issue, and to Ginger Croce in the AER office for her patience and support through the review process. Last, I thank my many colleagues for their article submissions and those who gave of their time, expertise, and energy in the review process.

Lauren Lieberman, PhD
The College at Brockport

Note from the Editor-in-Chief

I am very pleased to offer this special theme issue on recreation, leisure, sport, and play. About this topic, readers may ask "why?" and they may also ask "why now?" In answer to the first, I will say that an AER member wrote to me several years ago, just as the journal was getting started, and asked me to consider this theme. He stated that there was a paucity of resources, such as published articles on recent research, from which he could draw in his work with young people who are blind or visually impaired. And in answer to the second, it is important to note how timely this topic is! We have an epidemic of obesity among young people in North America right now, and many other related health concerns due, in part, to inactivity. People with vision impairments are perhaps even more susceptible to becoming sedentary. A quick scan of the "adapted physical education" and "therapeutic recreation" types of recently published articles shows that the specific limitations or barriers caused by partial sight or blindness are not common subjects for research attention in those fields. Therefore, it is important to make a contribution now to a field of research and practice that desperately needs attention through publications. I sincerely hope this special issue of *Insight* makes the contribution that is so needed right now.

Deborah Gold, PhD
Editor-in-Chief

Phases of Movement of Goalball Throw Related to Ball Velocity

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Abstract

The purpose of the investigation was to identify the phases of movement for the traditional and spin goalball throw and determine the correlation between ball velocity and time in each phase of movement. Twenty-nine goalball athletes (17 men, 12 women) competing at a United States Association for Blind Athletes Regional Goalball Tournament were recruited to participate. Descriptive task analysis of phases of movement, time spent in each phase, and ball velocity were identified and calculated using a digitally recorded video. Pearson's correlation determined relationships between ball velocity and time spent in each phase of movement. Three phases of movement were evident in both throws: (a) preparatory, (b) approach, and (c) follow-through. A fair relationship between ball velocity and time duration ($r = .38$) was evident in the approach phase of the traditional throw. Coaches should identify and understand the importance of phases of movement of the goalball throw for athlete development and improved coaching. Future investigators should conduct clinical 3-D kinematic analysis verifying phases and elements of movement that affect ball velocity and/or accuracy.

Keywords: goalball throw, phases of movement, ball velocity, sports performance, disability sport

Introduction

Goalball is a Paralympic sport that is played by individuals who are visually impaired and/or blind. The purpose of the game is to score a goal by throwing the goalball past the goal line of the opponent's team area (Davis, 2011). One offensive skill in goalball is throwing. Two common throws performed are the traditional throw and the spin throw. The traditional throw is an underhand throw that resembles the motion to bowling while the spin throw is performed with a rotating moving approach similar to the discus throw. There is currently no literature related to throwing performance of goalball athletes.

Identifying the phases of movement of a throwing skill can be a beginning step for a goalball coach addressing athlete development. It is necessary for a coach to understand and apply the phases of movement and key components within the movement when teaching or coaching goalball athletes. The analysis of sports skills is used to provide the way sports skills are performed and to improve performance. Performance can be achieved by identifying technique errors and faults and then intervening to correct those errors (Lees, 2002). Therefore, it can be assumed that goalball coaches who have the ability to break down the throwing skill into coachable

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phases of movement can begin to improve athlete performance (i.e., increased ball velocity or accuracy). Applying a sports skills model to the goalball throw is one method that can help coaches distinguish these phases and components of movement. Carr's (2004) model for sport skills analysis has four phases (i.e., preparatory movements, windup, force producing movements, and follow through). Although not recognized in goalball, sport skills analysis models are evident in traditional throwing sports such as softball (Flyger, Button, & Rishiraj, 2006), shot put (Coh, Stuhec, & Supej, 2008), discus (Yu, Broker, & Silvester, 2002), and baseball (Sachlikidis & Salter, 2007). Bowling is a sport that resembles the movement observed in throwing a goalball. Grinfelds and Hultstrand (1996) provided six fundamental steps of bowling (e.g., stance, pushaway, approach, swing, delivery, and follow through). Given the close resemblance to the traditional goalball throw, the steps recognized in bowling and Carr's (2004) sports skills model can be used to develop a task analysis of the goalball throw to further identify the phases of movement of the traditional and spin throw.

The traditional throw and the spin throws are two types of throws evident during goalball competition. Identifying the phases of movement for both the traditional and spin throw, along with the key components of movement, are necessary to advance goalball athletes' skill level. Since this has not been previously established for goalball, using the documentation of the rotational delivery (i.e., forward movement using a spiral run, 360°) of the spin throw for the sport of discus can serve as a model of performance for the spin throw in goalball. Rotational deliveries have been identified as improving discus and the shot put performance in sports for those without disabilities by increasing the speed of the approach (Paish, 2005). One offensive strategy in goalball is to throw the ball past the opponent's goal line; increased ball velocity would complement this strategy. Once the phases of movement of the goalball throw are identified, a coach can determine the importance of each phase as it plays a significant role in the performance of the throw, such as the increased ball velocity.

Improved athlete technique can lead to improved sports performance including increased ball velocity. One variable associated with performance is the time spent within each phase of movement. As an athlete delivers the throw, the time spent in each phase can impact the outcome of the throw. When reviewing the biomechanics of a glide shot put throw, Young (2007) defined movement phases as preparatory, takeoff, flight, and delivery phases, with the transition and completion phases as part of the delivery phase. Young analyzed the time spent in each phase of movement for the shot put glide throwing approach and reported that the elite athletes travelled a greater distance during the completion phases in a shorter period of time. An important point to consider is that the researcher reported a breakdown of the movement phases and identified that the variable of time in a movement phase could contribute to advanced performance of the shot put throw. The amount of time spent in a movement phase should also be applied to throwing the goalball. Therefore, the purpose of this study was to first identify the phases of movement of the traditional and spin goalball throws, and second, to evaluate the time in each phase of movement as it relates to the ball velocity. This study will offer useful coaching information through field based research.

Method

Participants

A total of 29 athletes (17 men, 12 women) who competed in a United States Association of Blind Athletes (USABA) 2010 Regional Goalball Tournament held at Western Michigan University were recruited to participate in this study. Athletes were individuals with a visual impairment and/or blindness and were classified as either as a B1, B2, B3, or B4 athlete. The amount of participants' categorized in each classification for men and woman are displayed in Table 1. The age of onset was not collected. Prior to data collection, university approval from the Institutional Review Board (IRB) was obtained and informed consent of each athlete was collected. Demographic data of the participants are provided in Table 2.

Procedures

During postgame observation and with eye shades on, each athlete threw the goalball three times using the traditional throw and three times using a spin throw. Athletes only threw the spin throw if it was part of their normal game repertoire. Of the three trials, the throw with the fastest ball velocity for

Table 1. Athlete Demographics

Gender	N	Age (years)	Years of Experience	Height (cm)	Weight (kg)
Males	17	27 (7)	7 (5)	177 (7)	94 (17)
Females	12	21 (6)	8 (5)	164 (5)	69 (10)

Note: Standard Deviations are in parentheses.

each type of throw was the one selected for analysis for all procedures. Ball velocity was determined through video observation and by dividing the distance of the neutral area (6 m) by the time. Time was determined by counting the number of frames on the video and dividing it by the digital recording frame rate (60 frames/s).

The phases of movement of the goalball throw were identified by observation of 2-D video. One digital video camera was set up perpendicular to athlete throwing. The distance from the throwing motion to the camera was not documented, however the entire throwing performance (i.e., the beginning of the throw until follow through) of each athlete was captured in the camera's field of view for both the traditional throw and the spin throw. Following all throwing sessions, data were analyzed to identity the phases of movement of the goalball throws, determine the beginning and ending points, and calculate the time within each phase. A Pearson correlation was used to determine if there was a relationship between the time spent in each phase of movement and ball velocity of the traditional and spin throws.

Results

Phases of Movement of the Traditional and Spin Goalball Throws

Using a descriptive task analysis, a total of three phases of movement in the goalball throw were identified: (a) preparatory, (b) approach, and (c) follow through. The approach had two subset phases: windup and delivery. These phases of movement were the same for both the traditional and spin goalball throw (see Table 3).

Table 2. Phases of Movement and Elements of the Traditional and Spin Goalball Throws

Phases of Movement	Elements
A. Preparatory phase	• Head positioned neutral to forward • Beginning balanced stance • Holding the ball ready • Initiating the first step of the approach
B. Approach phase	
1. Windup	• The approach (e.g., three-step or four-step), either linear or rotational • Extend throwing arm back to highest point of backswing
2. Delivery	• Forward motion of the throwing arm • Accelerating body segments from legs to throwing arm • Bending knees and lowering body and shoulder of throwing arm to the ground for ball release
C. Follow-through phase	• Shift in body weight • Bringing throwing arm and body forward after ball release

Phases of Movement

Table 3. Beginning/Ending Points and Mean Time within Phases of Goalball Throw

Phase of Movement	Movements Defining Phases	Traditional Throw ($n = 29$)	Spin Throw ($n = 10$)
A. Preparatory phase	• Initial foot movement • Heel strike of first step	0.22 s (0.06)	0.23 s (0.06)
B. Approach phase			
1. Wind-up 2. Delivery	• Heel strike of first step • Ball release from hand	0.67 s (0.18)	0.71 s (0.17)
C. Follow-through phase	• Ball release from hand • Forward first touch of the trailing foot	0.27 s (0.08)	0.24 s (0.04)
Total throw	• Initial foot movement • Forward first touch of the trailing foot	1.16 s (0.19)	1.18 s (0.16)

Note: Standard Deviations are in parentheses.

Each phase of movement was defined in order to determine the time in each phase. The preparatory phase was defined as the initial foot movement of the first step, and ending at the heel strike of that same first step. The head was positioned neutral to forward as the athlete located their beginning stance position and initiated the first step into the approach phase. Key elements observed within each phase are described in Table 3. Observation of the preparatory phase was different among athletes as some athletes stood up straight holding the ball with two hands in front of their chest, while others held the ball with two hands down by the ground bending forward at the waist. The different preparatory methods were only described for the phases of movement and were not considered in the analysis related to ball velocity.

The approach phase was described in two subset phases: (a) windup and (b) delivery. The approach phase began at the end of the preparatory phase (i.e., heel strike of the foot of the first step) through ball release. The windup phase consisted of the athletes bringing the ball back to the height of the backswing. The delivery phase began from the top of the backswing forward ending at ball release. Observation of the traditional throw demonstrated the athlete traveling in a forward linear motion, but the spin throw revealed a 360° rotational spin during these phases. Two-, three-, four-, or five-step approaches were observed while throwing for both throws. If an athlete demonstrated both types of throws, they used the same step count approach for each. The majority of athletes threw using a four-step approach ($n = 15$), followed by the three-step approach ($n = 9$), five-step approach ($n = 2$), two-step approach ($n = 1$), and two athletes threw without using any type of stepping approach (i.e., in stance, or jump).

The follow-through phase was described from ball release through a point when the trailing foot moved forward and touched the ground. After the ball was released there was a shift in body weight and the athlete's momentum continued forward causing the throwing arm and body to travel in the forward direction.

Time Spent in Phases of Movement

The time in each of the following phases was measured: (a) preparatory, (b) approach, (c) follow-through, and (d) time of the total throw. The phases of movement of the goalball throw, beginning and ending points of each phase, and mean time (seconds) calculated for each phase are provided in Table 4. The total time completing the traditional and spin throw were similar (1.16 and 1.18 s, respectively), although as seen in Table 4 most of the time in the throw was spent within the approach phase.

Using a Pearson correlation, the ball velocity of the traditional throw ($N = 29$) was significantly

Table 4. Pearson Correlation of the Time (s) in Phases of Movement and Ball Velocity

Phases of Movement	Traditional Throw	Spin Throw
Preparatory	.109	−.125
Approach	.377*	.216
Follow-through	−.051	.008
Total throw	.354	.108

*Note: *p < .05.*

correlated ($p < .05$) to the time (seconds) of the approach phase ($r = .38$) and should be considered a fair relationship. No other variables were significantly correlated to the ball velocity for either the traditional or spin goalball throw (see Table 5).

Ball Velocity

There were 17 males (17 traditional throws, 6 spin throws) and 12 females (12 traditional throws, 4 spin throws). Mean ball velocity for the traditional and spin goalball throws by gender and total group are reported in Table 6. The mean ball velocity of the traditional goalball throw ($N = 29$) was 20.68 m/s ($SD = 5.34$) and the mean ball velocity of the spin goalball ($n = 10$) was 25.52 m/s ($SD = 6.42$).

Discussion

The phases of movement for the goalball throw were identified (see Table 3) after applying Carr's (2004) model of sports skills analysis and the bowling phases presented by Grinfelds and Hultstrand (1996). Three phases identified through video observation were described as: (a) preparatory, (b) approach, and (c) follow-through. The approach had two subset phases, windup and delivery. These phases of movement were consistent between the traditional and spin throw. Similar to a study by Bowerman and Davis (2010), movement phases identified were reported using a sports skills analysis model (i.e., preparatory movements, windup, force producing movements, and follow-through). The importance of determining the phases of movement in goalball are important to coaches for athlete development. A coach's understanding and application of the identified phases of movement in the throwing skill can improve technique and training of goalball athletes. Examination of the data in the

Table 5. Mean Ball Velocity by Gender and Total Group for Traditional and Spin Throw

Group	Traditional	Spin
Males	23 (5)	30 (4)
Females	18 (4)	19 (2)
Total group	21 (5)	26 (6)

Note: Ball velocity is reported in m/s. Standard Deviations are reported in parentheses.

current study was through observation of field based 2-D video. A foundation of information was obtained related to the phases of movement, although conducting a more sophisticated study using 3-D video analysis in a clinical laboratory setting would provide more insight to the throwing skill in goalball.

Within the limitation of the study, it was found that athletes spent most of their time in the approach phase (see Table 4). This is useful coaching information, particularly because a significant correlation ($p < .05$) was identified between increased ball velocity of the traditional throw and the time spent in the approach phase ($r = .38$). Based on this finding related to the traditional goalball throw, results could imply the approach phase plays an important role in the performance of the goalball throw. The athletes who spent more time in the approach phase before ball release threw with a faster ball velocity. A number of factors could contribute to the findings of this relationship, such as the technique used in the approach (e.g., three step approach), distance travelled while throwing, or other throwing mechanics. However, future research is required.

In the current study, it was observed that a two, three, four or five step approach was utilized while demonstrating a traditional or spin goalball throw. The most common method observed was the four-step approach ($n = 15$), followed by the three-step ($n = 9$). Using a four-step technique is the also the most common footwork pattern observed in bowling (Grinfelds & Hultstrand, 1996). These approaches would most likely take more time to deliver compared to a two-step approach. In bowling, the purpose of the approach is to gain momentum to transfer to the ball release. In goalball, an athlete performing a four-step or three-step approach typically would take more time and would have a chance to gain more momentum that could transfer to the ball velocity of their throw. Time and distance are two factors that are considered when creating momentum and velocity. In bowling, in order to create more momentum, a greater distance should be travelled in a shorter amount of time (Grinfelds & Hultstrand, 1996). In the present study, although a relationship was found between the time in the approach phase and the ball velocity, the distance that the goalball athletes travelled during the traditional or spin throw was not collected. Future studies should consider evaluating this aspect of the throw to enhance the sports performance of the goalball throw.

In a study conducted on collegiate baseball pitchers, ball velocity was significantly correlated to a shorter time spent in the temporal phase of the pitch and having a larger body mass, as well as other biomechanical parameters (Werner, Suri, Guido, Meister, & Jones, 2008). Using the results of the pitching study, these authors suggested that improved training programs can be developed based on these data to increase ball velocity and performance of a collegiate baseball pitcher. Werner et al. (2008) discussed that a larger athlete threw the ball faster and that an athlete with larger body mass may be indicative of more strength. This can be applied towards the goalball throw and improving training programs for goalball athletes.

Implications for Practice

Using the concepts from Young (2007), improved training programs can be applied to goalball athletes to increase performance of the goalball throw. Identifying and understanding the phases of movement of the goalball throw is the first step in analyzing a skill. As previously stated, coaches can begin to breakdown the skill and focus on the specific movements within each phase. Without identifying these elements, a coach cannot target the specific actions that can improve throwing mechanics and technique that will increase performance, such as ball velocity or accuracy. Goalball coaches can also utilize the results of the current study (i.e., phases of movement) to develop training programs for their athletes. This begins with reviewing the key elements within each phase (see Table 3). In the preparatory phase, athletes can practice their balancing position and develop court awareness and orientation before throwing. Within the approach phase, athletes can learn specific techniques for their approach, working towards a more advanced step approach (i.e., four-step or three-step approach), which may improve performance. Since there was a significant correlation between the time in the approach phase and ball velocity, the four- or three-step approach may be more advantageous than a one- or two-step approach. Resistance strength training and power exercises are something that can be incorporated into goalball training programs. Such exercises could include the standing long jump or chest press. Flexibility and balance exercises would promote the ability of athletes to bend their knees, lower their bodies, and improve stride length while executing the throw. To work on the follow-through phase, athletes can practice transitioning their body weight forward after ball release.

Limitations of the Study and Recommendations for Future Research

As this study is a foundation to research in goalball, the small sample size affects the power of the correlation analysis and limits generalization. Although the traditional and spin goalball throws are not two-dimensional movements, the use of field-based testing and 2-D video analysis for data collection presented limitations. Coaches can make use of the phases of movement identified to develop an athlete's technique and outcome (e.g., velocity) by focusing on different aspects of the throw. Clinical 3-D testing is recommended for future analysis to verify the phases of movement identified in the current study. It is also suggested, but not limited to, performing a kinematic analysis of the goalball throw to determine various kinematic parameters of the throwing skill and how they relate to sports performance such as ball velocity and/or accuracy.

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Original Research

Improving the Lives of Youth with Visual Impairments through Exergames

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Abstract

People with visual impairments face several barriers when participating in physical activities. These barriers can result in a greater risk of developing serious health problems such as obesity. Exergames are video games that require large motions from the player in order to succeed in the game. This paper presents VI Fit, an open source exergaming platform dedicated to developing exergames for individuals with visual impairments. Three different exergames were created to encourage physical activity without requiring a video display. The energy expenditure was measured and shows promise that exergames created for people with visual impairments could contribute to a healthy lifestyle.

Keywords: exergames, video games, physical activity, visual impairment, blind, energy expenditure

Introduction

It has been suggested that individuals who are blind or visually impaired do not have the same opportunities to exercise as the general population due to the barriers to physical activity they face. These barriers can be divided into three categories: (a) *social* barriers are present when there is a requirement for an exercise partner or sighted guide (Shapiro, Moffett, Lieberman, & Dummer, 2005); (b) *safety* concerns of teachers, parents, and loved ones can prevent a person with a visual impairment from performing a physical activity (Lieberman & McHugh, 2001); and (c) *self-imposed* barriers are created internally based on not knowing what to do or the fear of being ridiculed (Stuart, Lieberman, & Hand, 2006). Due to these barriers, people with visual impairments are at a greater risk of developing serious health problems (Lieberman, Byrne, Mattern, Watt, & Fernandez-Vivo, 2010). However, people who are blind or visually impaired can exercise through open and closed adapted sports. Open sports are those where the variables in the sport change often such as beep baseball or goalball. In these sports, players must not only perform the physical activity of running to the base in beep

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baseball, or diving for the ball in goalball, but they must also perform the spatial challenge of adjusting to where the ball is located and the temporal challenge of when to strike the ball. Closed sports are those where variables remain constant such as tandem cycling or running on a treadmill. Running on a treadmill is simply running in place with no spatial challenge involved. Tandem cycling is the same, as a person with the visual impairment typically performs the muscle movement of pedaling, while relying on a sighted pilot to navigate through the course. Studies have shown that people who are blind or visually impaired prefer open sports to closed sports (Lieberman, Robinson, & Rollheiser, 2006). However, open sports are more difficult to make accessible due to the number of variables in the environment.

Although video games have been identified to be a contributing factor to obesity, a new genre of video games called *exergames* has been found to stimulate greater energy expenditure than when playing sedentary video games (Sell, Lillie, & Taylor, 2008). Exergames require large motions as input to the game, often mimicking a real world activity such as swinging a tennis racquet. Tennis is an example of an open exergame as the player must not only perform the motion, but must perform the motion at the correct time. Our research identified that exergames may have some unique properties that could allow individuals to overcome some of the barriers to physical activity that they face because: (a) exergames can lead to a greater independence as they do not require an exercise partner or sighted guide to be present; (b) exergames may be safer to perform than existing physical activities as they are performed in place; and (c) being able to play the same games as their sighted peers and family could increase socialization.

Background

Several video games have been created or modified for users with visual impairments or who are blind. They primarily use additional sounds to represent the necessary visuals in a different modality. Two examples of such video games are:

- *AudiOdyssey* (Glinert & Wyse, 2007) is a music game in which the player creates complex musical tracks. Players use a Nintendo® Wii™ remote to respond to audio instructions by making gestures.
- *Blind Hero* (Yuan & Folmer, 2008) makes use of additional haptic cues instead of additional audio cues. Haptic cues refer to the sense of touch. In *Blind Hero*, players play *Guitar Hero* by feeling vibrations directed to the finger that needs to press on the guitar buttons. Using haptic pathways for feedback is a good choice because many games already rely on audio cues. Adding more sounds could either make the game difficult to play because the additional sounds are lost in the midst of the original sounds, or the original sounds, which in some cases are vitally important to the game play experience, could be harder to perceive.

To assess the feasibility of exergames as a viable health intervention method that could aid people with visual impairments to overcome barriers to physical activity, the games must first be made accessible to such players. Existing exergames rely predominantly on visual stimuli to provide information about what input to provide and when. Modifying commercial exergames is difficult as the source code is proprietary and unavailable. Thus, the VI Fit platform was developed to make it easier to create exergames directed specifically at people with impaired or no vision.

VI Fit is an open source project, and, as such, all games built on this platform are free to download and use. The ability to modify existing games or create new games is encouraged. VI Fit runs on a Windows PC and contains support for Wii remotes, which are inexpensive motion sensing controllers, to capture body movements required by the games. Wii remotes are readily available, and contain methods to communicate directly to the player through nonvisual cues using audio through the built-in speaker, or haptic through the rumble capability. Using controllers that are inexpensive and creating software that runs on a regular PC were key requirements for this platform as it gives more people access to the games. Games created for the VI Fit platform and modeled after commercial titles must go through a process known as sensory substitution (Bach-y-Rita & Kercel, 2003). This is the process of converting required visuals to haptic and/or audio cues while trying to not affect the fun factor of the original game.

This paper documents the first three games created with the VI Fit platform: *VI Tennis* (Morelli, Foley, Columna, Lieberman, & Folmer, 2010), *VI Bowling* (Morelli, Foley, & Folmer, 2010), and *Pet-N-Punch* (Morelli, Foley, Lieberman, & Folmer, 2011). Each of the games were created and evaluated using the following steps: (1) create the game without visuals by using sensory substitution, (2) perform a user study, and (3) analyze what was learned from the user study. Through that process, the following research questions were posed:

1. Can exergames be created using nonvisual modalities?
2. Does a combination of audio/haptic cues result in better performance when compared to audio cues alone?
3. Can nonvisual modalities be used to orient a person in a proper direction?
4. Do exergames utilizing both arms provide more energy expenditure than games using the dominant arm?
5. Are exergames utilizing both arms significantly more error-prone than games utilizing the dominant arm?
6. Can exergames using nonvisual modalities provide a fun gaming experience?

VI Tennis was designed to answer the first two questions, *VI Bowling* was designed to answer question number three, and *Pet-N-Punch* was designed to answer questions 4, 5, and 6. Each of the games and their associated studies are described in the following sections.

VI Tennis

VI Tennis was based on the highly successful game *Wii Tennis*, which is part of the *Wii Sports* software bundle. *Wii Sports* has sold over 76 million copies worldwide (Nintendo, 2011). Outside of the popularity of the commercial game, a tennis game was chosen because it contains several features that are attractive for research purposes: (a) it has simple controls, (b) it is easily modified for different levels of player abilities, and (c) it represents simple game play.

Methods

Wii Tennis is inaccessible to a player with low or no vision, due to the fact that several key items are only represented as visuals. Most importantly, the position of the ball and the position of the players are largely shown only by visuals. Important cues such as the score of the game or set are only displayed as visuals. Although a player can succeed in the game without knowing the score, the enjoyment of the game is based on either winning or losing. Other cues such as the notification of when it is time for the player to serve or when the virtual opponent is about to serve, are all completely visual.

Using the *Wii Tennis* game as a basis, the sensory substitution process was performed to create a new game using the VI Fit platform. The goal of the sensory substitution process is to enhance the game by converting important visual cues to either vibrations or sounds without affecting the overall gameplay experience. As a general rule, new sounds are added when they will not interfere with the existing game, and vibrations are used when adding a new sound could interfere with the existing game. The process began by creating a tennis game without a display that contains the sounds found in a game of tennis. The sound of the ball bouncing, the crowd cheering, the player swinging, and the player hitting the ball were all included. Next, the important visuals were substituted for other modalities. The display of the score was converted to an announcer's voice notifying the players of the score at the conclusion of each point. The visual state of the ball was converted to two haptic cues. The first cue was a short vibration (250 ms) when the ball was bouncing. This was to give the player an indication that it was almost time to swing. When the ball was located in the area where a player could hit the ball, a second haptic cue was presented by the haptic rumble in the Wii remote constantly buzzing. This was a sign to the player it was time to swing. The player had 2000 ms to correctly swing.

After the sensory substitution process, *VI Tennis* was ready to be tested by a player. The player would hold a Wii remote in the dominant arm. An announcer would audibly announce who the server was (Player 1 or Player 2), then the player would make a motion with the Wii remote to start the point off. The ball would audibly bounce once it was on the other side of the net, which would also be accompanied by a short vibration in the controller if the ball was approaching the player (no buzz would be felt if the ball was approaching the opponent). When it was time to hit the ball, the controller would vibrate constantly throughout the window of time where a hit was acceptable. Once one of the players did not successfully hit the ball, the point would end and the score would be announced by the announcer.

User Study: *VI Tennis*

A user study was performed with 13 children (9 male) with an average age of 12.6 (standard deviation [SD] = 2.5) years who are blind at Camp Abilities, a developmental sports camp for children who are visually impaired, blind, or deaf-blind. The children were selected prior to their arrival at Camp Abilities and, along with their parents, consented to the study. All children in the study were classified as B1 athletes by the U.S. Association of Blind Athletes, which means they are totally blind with no functional vision. Children with orthopedic impairments were excluded from this study. The purpose of the study was to determine the energy expenditure of an exergame created for a player who is blind and to assess the effectiveness of the combination of haptic and audio cues when compared to only audio cues. Two different versions of *VI Tennis* were evaluated and compared. The first version is the one produced as described above (audio and haptic), and the second version contained no haptic cues, just audio. To avoid any error in statistics based on familiarity with the game or an order effect, players were randomly assigned into two groups. The first group played audio/haptic on the first day and audio only on the second day, and the other group played them in the reverse order. Player performance and energy expenditure were measured, and a questionnaire about the subjective experience was administered at the conclusion of the study.

Player performance was measured by level at the degree of player success while playing the game. The player's ability was rated on a scale from 1 to 10. A score of 1 meant a player was likely to successfully hit 1 out of 10 balls correctly, and level 10 meant a player was likely to hit 10 out of 10 balls correctly. The player level was adjusted every five points, and could only be adjusted by one level in either direction. All players started out at a level 6. Energy expenditure was measured by using Actical accelerometers worn on the wrist of the player's dominant arm. It has been shown that placing an accelerometer on the wrist is an accurate way of measuring energy expenditure (Heil, 2006). Players were given a 5-minute warm-up period to familiarize themselves with the game. After the 5-minute warm-up period, players played the game for 10 minutes. All results are based on data collected from the 10-minute session.

Results

Figure 1 shows significant difference between the playability of the haptic/audio version versus the audio version. In the haptic/audio version, the player successfully hit the ball more often as shown by the level increase. In the audio-only version of the game, the player was initially not able to successfully hit the ball, which is indicated by the drop in the level. A series of Wilcoxon signed-rank test was performed at 1-minute intervals. A significant difference ($Z_{2,12} = 2.83$, $p < 0.01$) first appeared after 3 minutes of play and shows that an exergame utilizing both haptic and audio cues is easier to play than an exergame that only contains audio cues. The divergence may have taken 3 minutes due to the nature in which the player level was adjusted. Had the player level been adjusted more or less frequently, this divergence could have occurred at a different time.

There was no significant difference in the average energy expenditure between the two games. The average energy expenditure for both games combined was 16.9 (SD = 7.4) kJ/min. Both games were played for 10 minutes. At the conclusion of a point, the next point would either start immediately, or if the player was to serve, he or she would be given the opportunity to serve immediately. In effect, the same number of motions was performed between a player who was successful, and a player who was not.

Children participating in the study were asked open-ended questions at the conclusion of the second playing session. The interviews were performed one on one and were informal. Questions included: Did you like playing each game?, Which version of the game did you prefer and why?, Have you played Wii games before?, and How do you think each game could be improved? The answers to these questions were analyzed for recurring themes. Overall, children were very excited to play the games. Five children had played video games before, and only one child had played a Wii game (*Wii Bowling*). All children preferred the audio/haptic version. One child stated, "with sounds it's like we have to pay more attention, but with vibrations I just feel it and just hit or swing the remote."

VI Bowling

One aspect observed in the *VI Tennis* study was how the players played the game. Players could swing in any direction and even face any direction.

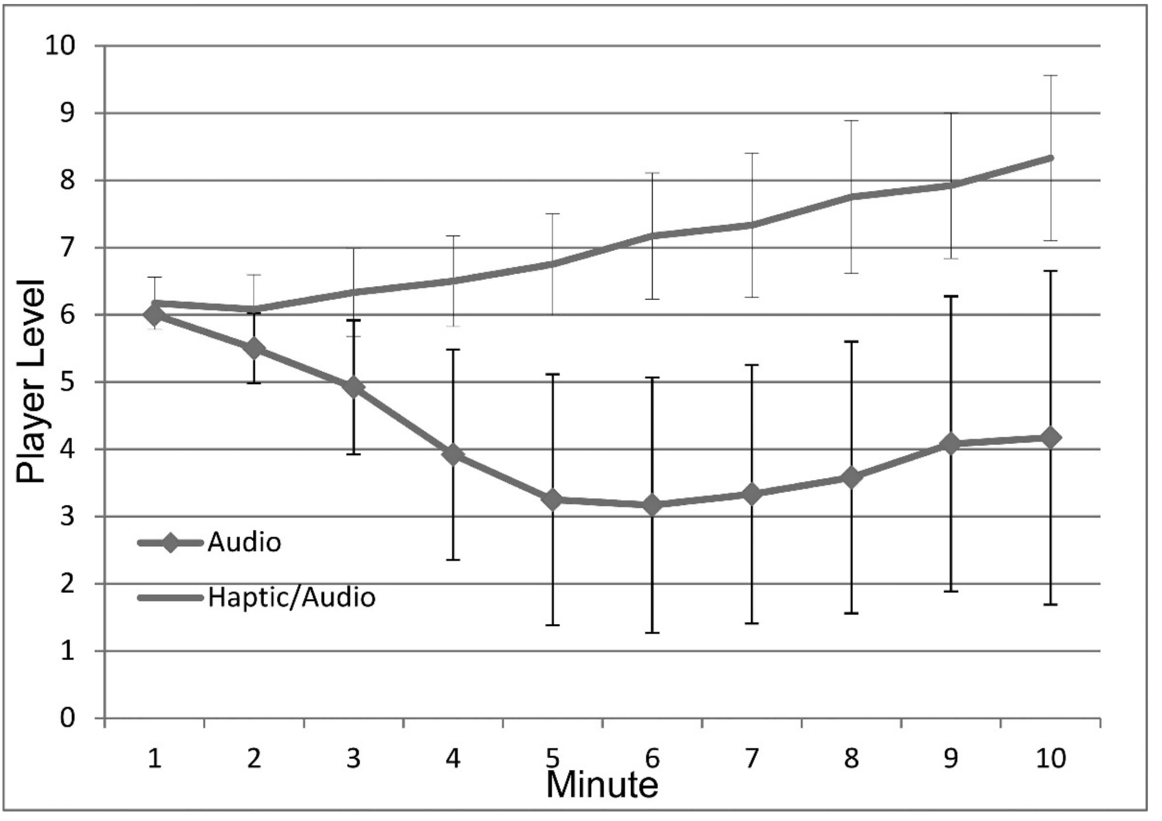

Figure 1. VI Tennis *player performance audio versus haptic/audio.*

This made the game easy to play, but in some instances it may be necessary to orient the player and to have him make specific motions. *VI Bowling* was created to analyze the possibilities of forcing players to make correct motions in correct directions, and to examine the energy expenditure of a self-paced exergame for people who are blind or visually impaired.

Methods

VI Bowling is based on Wii Sports Bowling. In Wii Bowling, players play a virtual game of bowling by holding a motion-sensing controller in the dominant arm and making a physical motion of rolling a bowling ball. The sensory substitution process was once again followed when creating the new game with the *VI Fit* platform. Sounds of the ball rolling, and pins crashing were brought into the game first. Additional voice-over sounds were needed to describe the current score, the current frame, the number of pins down, and the number of pins remaining.

Notifying the player where the pins were located provided a new challenge. Showing the player where the pins were located was achieved through *tactile dowsing*. Players utilized their Wii remote as a dowsing rod, moving it from side to side until the pins were located. The location of pins was revealed through a series of haptic pulses. The Wii remote would give a short haptic vibration to indicate to the player how close he or she was to finding the center of the pins. The delay between haptic pulses was directly related to how close to the center of the pins the player was pointing the Wii remote. The closer to the center of the pins, the shorter the delay was between pulses. Players would move the Wii remote side to side until the haptic buzz was constant, which indicates the center of the pins. A haptic window of 19.3° on either side of the center of the pins would provide some amount of tactile feedback. At the edges of this window, the vibration would pulse for 125 ms followed by a 2500 ms delay. The delay decreased linearly by 125 ms for every 1° closer to the center of the pins. Once the target was located, players would perform a bowling motion to throw the ball. If the player's aim was to the right of center, on the following throw the remaining pins would be located on the left side and the player needed to locate the remaining pins through tactile dowsing. The closer to the center of the pins, the more pins are knocked down.

User Study: *VI Bowling*

VI Bowling (Figure 2) was evaluated with 6 adults (4 male) who are blind or visually impaired with an average age of 58 (SD = 21) years. Two participants were totally blind, and four were visually impaired. Adults with orthopedic impairments were excluded from this study. Participants were recruited at a meeting for the Northern Nevada Chapter of the Nevada Federation for the Blind. At the conclusion of their monthly meeting, members were given a description of the *VI Bowling* game and asked if they would like to stay after the meeting and play the game. Players were equipped with Actical accelerometers to measure energy expenditure, and statistics were gathered as the players played through the game to measure the effectiveness of tactile dowsing. Interviews about the subjective experience of playing were conducted with each player at the conclusion of each user test.

Players played through all 10 frames of a typical bowling game. Accuracy was measured based on how close the player was to the center of the virtual pins at the conclusion of the bowling motion. A strike was any throw within 3.8° of the center of the pins. To get one pin down the player was required to be within 19.3° degrees of the center of the pins. The distribution of knocking down 2–9 pins is distributed linearly through this range. The desire to knock down more pins encouraged players to find a point in space and to return to that exact point when performing the swinging motion.

Results

Participants achieved an average energy expenditure (AEE) of 4.61 (SD = 1.62) kJ/min. Compared to *VI Tennis*, where the ball must be hit within a certain time period, this low AEE can be attributed to the self-paced nature of the game. Players took their time in lining up the pins in order to make an accurate throw. This is similar to real bowling where players can take as much time as needed between throws, and where energy expenditure is lower than in the real game of tennis.

The average time it took to find the target was 8.78 (SD = 8.34) seconds. Although the search time decreased throughout the game, there was no significant amount of difference between the search time in the beginning of the game when compared to the end of the game ($T_{2,34} = 0.28$, $p > 0.05$).

The average accuracy when locating the target was 9.76° (SD = 6.23). To determine if there was in increase in accuracy throughout the game, the number of pins knocked down over the entire frame was dichotomized (1 if all pins were knocked down, 0 if not). A McNemar test using a 2×2 contingency table was used to compare the first three frames with the last three frames and showed participants became more accurate with throwing as they significantly increased their ability to finish a frame with all pins knocked down over the course of the game (X^2 [1,34], $p = .02$).

Players in the study were asked questions on a five point Likert scale to determine the usability and playability of *VI Bowling*. All players had played bowling before, but had not played Wii Bowling or a Wii Game. All participants liked *VI Bowling* ($M = 5.0$) and found the game easy to play ($M = 4.6$, SD = 0.52). All participants except for one felt the game could help them exercise ($M = 4.0$, SD = 1.66) and tactile dowsing was found to be challenging ($M = 4.5$, SD = 0.55). One player suggested modifying the vibrations such that they contained a more gradual increase over a wider range.

Pet-N-Punch

The game, *Pet-N-Punch*, was created specifically to address several issues identified in the first two VI Fit games relating to energy expenditure and game play experience. Created from scratch and not based on any commercially available game, the goal of this game was to emphasize correct motions and deter incorrect motions in a timely manner, with the hope to increase energy expenditure and replay value.

Methods

Pet-N-Punch is a virtual game based loosely on the arcade game for small children called Whac-A-Mole. In Whac-A-Mole, players hold a large padded hammer in one hand and hit moles on the head with the hammer when they pop out of one of the 5 mole holes on the playing board. This game is particularly difficult for a person with a visual impairment to play as it is based almost entirely on the need to see the animal heads popping out of the holes, and to see them using the peripheral vision.

Figure 2. *Man with visual impairment playing* VI Bowling.

In *VI Tennis*, players could succeed in the game by simply swinging wildly. This would not create a long lasting satisfactory game play experience. In order for these games to yield any long-term health benefits, they will need to be played on a long-term basis. In *Pet-N-Punch*, players would be penalized for swinging wildly in order to create a skill based game that players would want to play again and again in order to hone their skills.

Pet-N-Punch is based on the premise that the player is helping a farmer rid his farm of rodents. Rodents appear in the game represented by sound and vibrations, and players would need to hit the rodent on the head. This action is performed by using the Wii remote in a hammer like fashion by swinging down quickly. Rodents could appear on either side of the player so players were equipped with two Wii remotes, one in each hand. Players would know which side the rodent was on based on sounds (sounds would be played out of either the left or right speaker) and vibrations (the controller closest to the rodent would constantly vibrate). In order to prevent a player from succeeding by swinging wildly and in turn lowering the long-term replay potential, cats were introduced into the playing fields. Players would lose points if the cats were hit on the head. Instead of hitting them on the head, players were instructed to gently pet the cats. This kept the players on edge waiting for the next creature to appear. As opposed to the constant vibration associated with a rodent, the controller would vibrate for 250ms to announce the presence of a cat. Successfully used in the *VI Bowling* game, in-game tutorials were used to show the players how to hit hard, and how to hit soft.

User Study: *Pet-N-Punch*

A user study was performed using *Pet-N-Punch* with 12 children (8 male) with an average age of 12.2 (SD = 2.01) years at Camp Abilities, a developmental sports camp for children who are visually impaired, blind or deaf-blind. The children were selected prior to their arrival at Camp Abilities and players, along with their parents, consented to their participation in the study. All children in the study were classified as B1 athletes by the U.S. Association of Blind Athletes, which means they are totally blind with no functional vision. Children with orthopedic impairments were excluded from this study. Although the methods used to select participants in this study are similar to *VI Tennis*, the studies did not contain the same participants and were performed 1 year apart. Energy expenditure was measured and accuracy data was collected to analyze the complications of an exergame utilizing both arms. As with the other user studies, interviews about the subjective experience were conducted at the conclusion of each player's participation in the user test. Players participating in the study wore

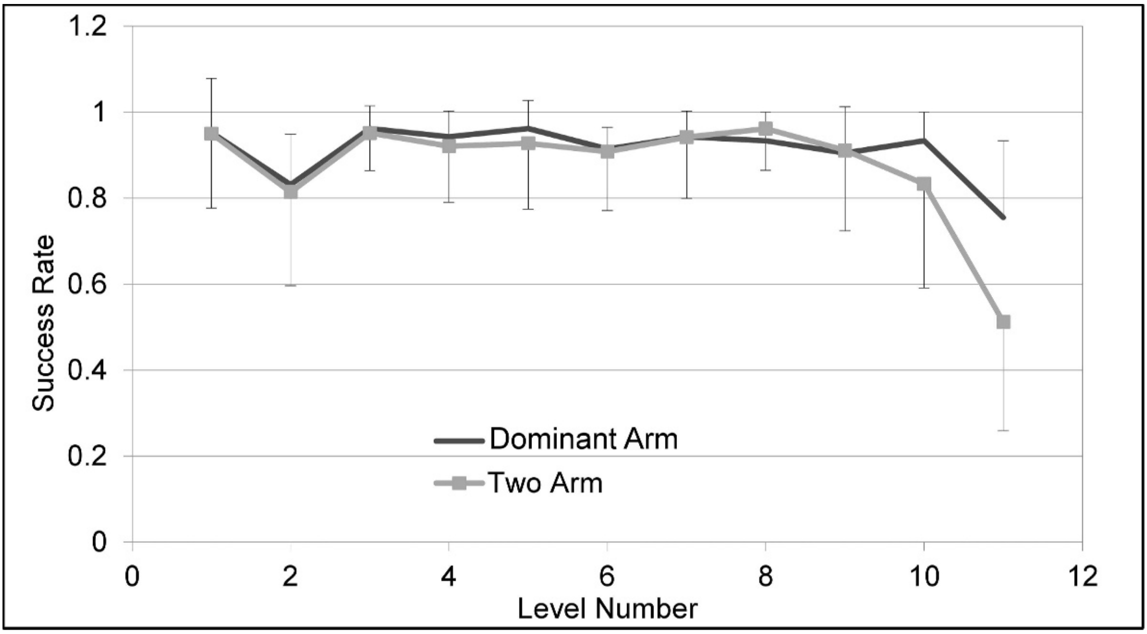

Figure 3. Pet-N-Punch *success rate versus level number.*

Actical accelerometers on both wrists to measure energy expenditure and data from the two were averaged.

The study consisted of the players playing through two versions of the game. One version utilized both arms, and the other version required movements of only the player's dominant arm. The study took place over 2 days. All participants in the study played both games, with a randomly chosen half playing the dominant-arm version on day 1 and the two-arm version on day 2. The other half played both games in the reverse order. The gameplay was the same for both versions of the game, where players would encounter 80 percent rodents and 20 percent cats throughout each level. The number of creatures encountered was consistent between both versions of the game. Each level presented the creatures progressively faster. The first level required the player to provide the correct motion within 4500 ms with a 2000 ms delay between creatures. The last level had the creatures appearing every 500 ms with the required response time also at 500 ms. Players played the game for a total of 10 minutes through 11 levels.

Results

A Wilcoxon signed-rank test shows significant difference in accuracy between the dominant-arm version of the game when compared to the two-arm version, with the two-arm version being significantly less accurate than the dominant-arm version ($Z_{2,12} = 2.325$, $p < 0.05$). This can be attributed to the player needing to make a decision as to which side of the body needed to be moved in the two-arm version, when compared to the dominant-arm version where this information was already known. Figure 3 shows the accuracy also dropped in the latter levels for both versions of the game.

The energy expenditure was not significantly different between the two versions of the game ($Z_{2,11} = 0.53$, $p > 0.05$). The average energy expenditure for both games combined was 11.26 (SD $=$ 1.06) kJ/min. The energy expenditure dropped off in the latter levels (Figure 4). This drop in energy expenditure followed the drop in accuracy. As cues were presented more frequently, players could not react fast enough and would pause their motions as a method of getting back in sync with the game. Faster cue presentation does not result in more energy expenditure. This study shows that 2.5 seconds is the amount of time to give a player to not only react to the cue, but to perform the desired motion.

Participants in the study were asked 18 questions on an 8-point Likert scale. The questions were designed to find an enjoyment level based on a Physical Activity Enjoyment Scale (PACES) (Kendzierski & DeCarlo, 1991). The maximum score possible was

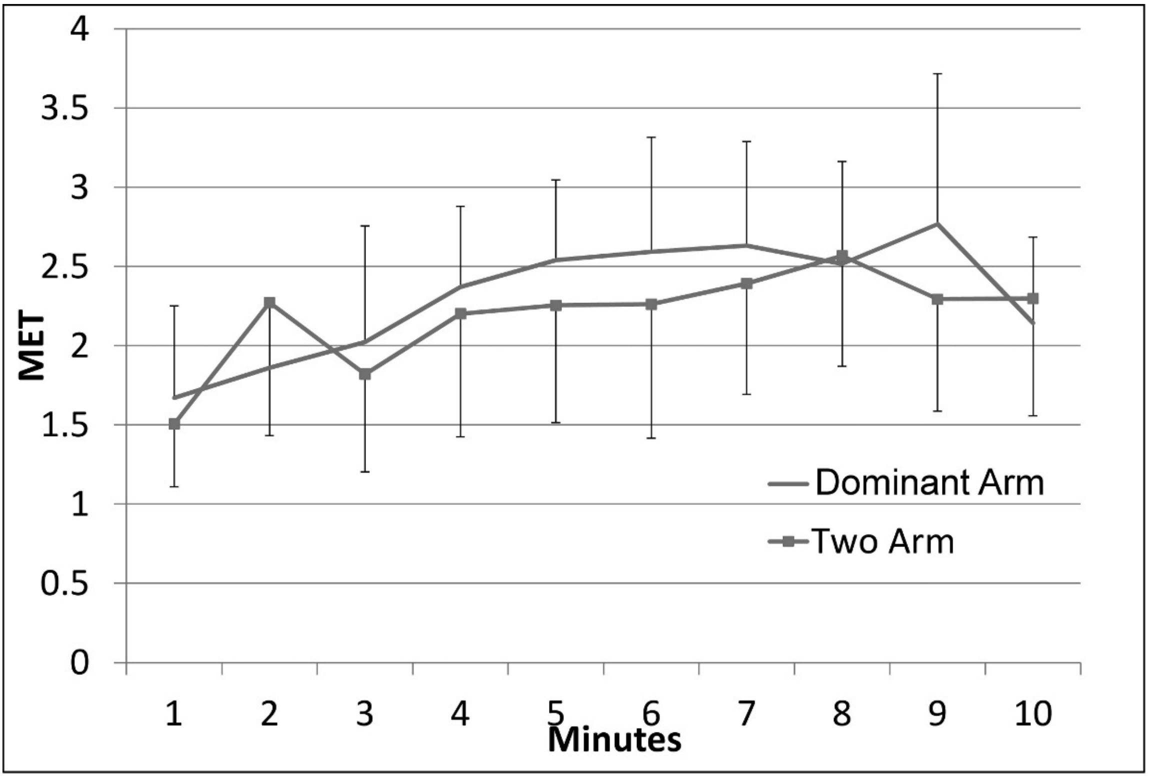

Figure 4. Pet-N-Punch *energy expenditure in metabolic equivalents (MET) versus time.*

144, with the minimum being 18. The results of the survey for this game found the average to be 131.3 (SD = 13.42). This high enjoyment level may indicate a desire to play the game again, which is required for long-term health benefits. Another manuscript reporting on enjoyment levels has been submitted for publication.

Overall Results

Table 1 shows a comparison of Average Energy Expenditure (AEE) between all three game titles. *VI Tennis* has the highest AEE, followed by *Pet-N-Punch*, and *VI Bowling* had the lowest. *VI Tennis* allowed players to swing constantly with no punishment and this could have added to the energy expenditure. Players could swing twice or three times during each point and not be penalized. *Pet-N-Punch*, however, would penalize players for this style of play by taking away points if a player hit one of the cats.

The low AEE of *VI Bowling* can be explained by the self-paced nature of the game. There was no incentive for the player to hurry up and throw the ball. A player could achieve a higher score by taking his time and correctly lining up for an accurate throw. *VI Bowling* did show that tactile dowsing was a good method for orienting a player.

The drop in energy expenditure along with the drop in accuracy shown in *Pet-N-Punch* demonstrates that simply presenting cues at a higher rate is not sufficient to produce a higher energy expenditure. Cues should be given at intervals lengthy enough that a player can be in constant motion as opposed to stopping when errors start occurring.

Discussion

These studies have further expanded existing VI accessible games such as AudiOdyssey and Blind Hero. Although those games were accessible to a person who is blind or visually impaired, they may

Table 1. Average Energy Expenditure per Game

Game Title	Average Energy Expenditure (kJ/min)
VI Tennis	17 (SD = 7)
Pet-N-Punch	11 (SD = 1)
VI Bowling	5 (SD = 2)

not have provided any additional energy expenditure as that was not measured. In these studies, not only were accessible games created for people with limited or no vision, but the energy expenditure was measured and showed that the players were active. The games created were chosen due to their open sports characteristics and players were given both a motion and a spatial or timing challenge. These studies have shown that creating adapted exergames is possible and have laid the groundwork for future games to be created that can possibly have a higher energy expenditure than any of the three games created so far.

All of the games in these studies showed an increase of energy expenditure, with the lowest amount of energy expenditure (*VI Bowling*) being equivalent to walking. This shows that exergames can be created using nonvisual modalities. *VI Tennis* shows that a combination of audio/haptic cues results in significantly better performance when compared to a game using audio cues alone. Exergames created for these users should contain both audio and haptic cues to inform a person to react. Players were able to orient themselves in the proper direction through the use of nonvisual modalities as shown in the *VI Bowling* study. Tactile dowsing allowed a player to locate a point in space without any visual cues. The *Pet-N-Punch* study showed that there was no significant difference in energy expenditure in an exergame using the dominant arm versus an exergame using both arms, however there was a significant difference in error rates with the two-arm version of the game having a significantly higher error rate than the dominant-arm version. And finally, based on the player surveys and a high PACES score, exergames using only nonvisual modalities can provide a fun gaming experience to players. This is important as a game that is fun to play is more likely to be played again and in order to have any long-term health benefits, it will have to be played over a long period of time. The results of these user tests, including the informal interviews about the subjective experience of playing the games, will permit the development of other games in the future—games that feature elements that are exciting and interesting to players who are blind or visually impaired.

Limitations

One limitation of the *Pet-N-Punch* study was the method used to test the effectiveness of using both arms as compared to using the dominant arm only. There was no significant difference in energy expenditure between the two. Although both arms were in motion, they were never required to be in motion at the same time. A game that required both arms to be in motion at the same time may have resulted in significantly higher energy expenditure for the two-arm version. Also, some participants in the study tended to show self-stimulatory behavior, or rocking. This was shown by participants performing extra motions not required for the game such as moving around in a circle or moving the non-dominant arm in the one arm version of the game. This behavior was observed but not measured.

The error rates for *VI Tennis* and *Pet-N-Punch* were for children. It is unknown if these rates will remain constant for adults as well. In addition to a difference in error rates, an older person may perform the motions differently than a younger person and the measured amount of energy expenditure could vary based on age.

The results for *VI Bowling* were from an adult user base. It is unknown if a younger group would have the same results. In order to succeed at finding the target, a slow and steady motion was required. A younger participant may move too quickly and skip over the target resulting in a longer search time.

The duration of the studies was relatively short. All of these games involved studies of about 10 minutes in length. It is unknown if player attitudes or abilities would change if the games were played for a longer amount of time.

Future Work

The results show an increase in energy expenditure for all the games, but the increase could be higher. We suggest creating exergames that utilize whole body movements. Also, although we have shown an increase in energy expenditure, it is unknown whether or not any long-term health benefits exist. We suggest a long-term study using exergames accessible to people with visual impairments as a mechanism for daily exercise. Furthermore, the techniques learned in the three user studies may be helpful to develop a nonvisual-based method for learning body motions. *VI Bowling* showed that players can make a proper bowling motion using nonvisual cues, and this concept could be expanded. Physical therapy could be a possible area to explore further, where the desired motions are conveyed to the patient through sounds and vibrations and their correct motion is determined using similar techniques.

Conclusion

This paper presents the VI Fit platform, an open source exergaming platform for people who are blind or visually impaired. The progression of the first three games created on this platform started with a simple tennis game, and progressed throughout by creating new games with the purpose of testing specific features. *VI Tennis* showed a significant difference in player ability and player surveys demonstrating that a game utilizing both audio and haptic cues is better than a game utilizing only audio cues. *VI Bowling* demonstrated how to orient a player and require certain movements, but also showed the lack of energy expenditure in a self-paced game. *Pet-N-Punch* extended the haptic cues used in *VI Tennis* and *VI Bowling* and overcame the potential for a player to swing wildly in a non self-paced game. Although the AEE for *Pet-N-Punch* was lower than *VI Tennis*, the requirement for the player to wait for the cue, and then respond could result in long-term replay value. Future work will investigate the long-term health benefits, methods of increasing energy expenditure, and methods for motor learning.

Author's Note

Some results reported in this paper have been previously reported in the proceedings of meetings in the computer science field and are referenced.

Acknowledgment

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Original Research

Enjoyment Levels of Youth with Visual Impairments Playing Different Exergames

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Abstract

One possible method to engage youth with visual impairments in physical activity may be exergaming. The purpose of this study was to measure differences in the enjoyment levels of youths with visual impairments playing three commercially available exergames. Participants ($n = 12$) ages 9 to 16 years old with a visual impairment were randomly assigned one of three games on three separate nights and played each game for 10 minutes. Games played were *Dance Dance Revolution Extreme 2* (*DDR*), *EyeToy Kinetic*, and *Wii Boxing*. After each game participants filled out the Physical Activity Enjoyment Scale. The scores were summed for final analysis with a highest attainable score of 144. A Friedman's ANOVA was used to analyze the data. Players of the three different games showed no significant difference in their enjoyment between games. The consistently high mean scores attained by all three of the exergames (*DDR* = 129 [20.9], *EyeToy* = 127 [23.4], *Wii* = 137.67 [9.4]) indicate that the participants enjoyed playing these games. This result suggests that youth with visual impairments can enjoy being physically active through use of the exergames.

Keywords: physical activity, exergames, physical education, Physical Activity Enjoyment Scale

Introduction

The U.S. Department of Health and Human Services (2008) has released the most recent physical activity guidelines for both adults and children. These

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guidelines are based on an extensive review of the scientific literature and determined that children benefit from an hour or more of physical activity a day. A positive relationship between physical activity and cardiorespiratory fitness in youth has been suggested (Shephard, 1992; Payne & Morrow, 1993). Moderate physical activity has been shown to improve children's self-esteem and body image as well as reduce depression and anxiety levels (Bryant et al., 2010). Getting children active is critical since studies have shown that obesity in childhood may be a precursor to obesity in adulthood, and children who are physically active are more likely to become active adults who will benefit from exercise throughout their lives.

Wankel (1985) has suggested that enjoyment plays an important role in exercise and sport participation. A direct influence on behavior, enjoyment can provide an immediate reward for being physically active (Dishman et al., 2005). Therefore, it can be assumed that an increase in enjoyment could lead to an increase in physical activity. Enjoyment of an activity serves as a key determinant when one decides whether or not to allocate time toward that activity (Graves et al., 2010). In response to declining rates of physical activity among adolescents, more opportunities for physical activity that children enjoy must be discovered.

The increasingly sedentary lifestyles of children are setting them up for negative health outcomes including diabetes, hypertension, and cardiovascular disease (Stephens, 2002). Little has been done to successfully combat the lack of physical activity seen in adolescents. Nader and colleagues (2008, 2009) indicate that the average moderate–vigorous physical activity (MVPA) rate of children decreases between the ages of 9 and 15 years of age during both the weekday and weekend. While approximately 99 percent of 9-year-olds were engaged in at least 60 minutes of MVPA during the weekday, less than 32 percent of the 15-year-olds were engaged in 60 minutes of MVPA during the weekday. This ultimately brings children below the recommended amount of 60 minutes of MVPA. This is consistent with other data that suggest that two-thirds of adolescents did not reach the recommendation of at least 60 minutes of moderate physical activity, 5 days a week (Kerr, 2007).

While disparities in MVPA exist between youth with and without disabilities, they also exist between types of disabilities. Research by Longmuir and Bar-Or (2000) suggested that individuals with visual impairments tend to have lower physical activity levels than their peers with physical and chronic disabilities. Further, they concluded that only 27 percent of children with some visual impairment are habitually active. Hence, the greatest risk of a sedentary lifestyle is by youths with visual impairment. It is clear that more opportunities for physical activity for those individuals are needed.

Boone, Gordon-Larsen, Adair, & Popkin (2007) point to the growth in home technology for the increased sedentary behavior of youth today. Clocksin, Watson, and Ransdell (2002) have argued that sedentary leisure-time activities are gaining popularity among children and adolescents, and that these activities are linked to decreased physical activity and increased body mass index (BMI). It is believed that leisure-time sedentary behaviors can be addressed by reducing media use including television, nonacademic computer use, and inactive video game playing. Conversely, there has been research done that provides evidence that video games may be beneficial to both those with visual impairments and those without (Wang & Perry, 2006; Morelli, Foley, Lieberman, & Folmer, 2011). Certain video games can increase both visual field and reaction time of the participants (Green & Bavelier, 2003). Yang & Foley (2011) recommend exergames as a way to improve motor skills and increase physical activity levels of youth with disabilities.

Gasperetti et al. (2010) suggests that youth with visual impairments may receive health benefits by participating in exergames. Research by Morelli and colleagues (2010, 2011) provided evidence that youth with visual impairments can reach MVPA levels that provide health benefits while playing exergames specifically designed with a tactical interface. However, little information exists on whether youth with visual impairments actually enjoy playing exergames, specifically those with a graphic user interface. The purpose of this study was to investigate if youths with visual impairments experience different enjoyment levels after playing three commercially available exergames.

Methods

Participants

The youths attended a 1-week overnight sports camp in upstate New York for youth with visual

Table 1. Descriptive Data of the Participants

	M	*SD*
Age (years)	13	2
Height (cm)	148	14
Weight (kg)	48	14
BMI	22	6

Note: Height, weight, and BMI are listed for 11 of the 12 participants.

impairments. Prior to their arrival at camp, 15 youths were identified as being qualified to participate in this study. To limit confounding variables, inclusion criteria were the following: no orthopedic impairment, no intellectual disability, and a United States Association for Blind Athletes (2009) classification of B2 or B3. Athletes with a B2 classification have the ability to recognize the shape of a hand up to visual acuity of 20/600, and athletes with a B3 have a visual acuity between 20/600 and 20/200. Of those identified, seven males and five females volunteered to participate in the study. Parents signed consent forms and the participants signed an assent document that was offered in both large print and braille. Descriptive data of the participants can be found in Table 1.

Procedure

The participants were randomly assigned to play three exergames previously modified for use in this study and others (Gasperetti et al., 2010). Games were projected on a large screen from a projector positioned overhead; this allowed the participants to stand approximately 6 feet from the screen. The interactive games used in the study were *Dance Dance Revolution Extreme 2* (*DDR*), *EyeToy Kinetic*, and *Wii Boxing*. All of the games provide the user with both visual and auditory feedback.

All of the campers had one-on-one counselors who were responsible for getting their athlete to the gaming area when the study was taking place. The participants played one of the three interactive games a night for 10 minutes. When playing *DDR*, participants were asked to choose five songs and were also allowed to pick the difficulty level at which they played. The *EyeToy Kinetic* game called *Breakspeed* runs for about 3 minutes at a time so the participants played the game three times. During *Wii Boxing* the participants were allowed to play as many rounds as they could within the allotted 10 minutes.

After playing each of the interactive games, which were played on separate nights, the camp counselor would ask the participant the questions that make up the Physical Activity Enjoyment Scale (PACES), which was developed by Kendzierski and DeCarlo (1991). The questions in the survey are meant to measure the enjoyment levels of physical activity in a given area or event. In this case, it measures the enjoyment levels of players who participated in the physically active video games. The 18 questions that make up the PACES are answered on a 1 (lowest) to 8 (highest) Likert scale. The scale was modified from a 7-point to an 8-point scale to force a positive or negative response.

In the original work by Kendzierski and DeCarlo (1991), they studied the construct validity as well as the internal consistency of the PACES with undergraduate students. Their results found a high internal consistency ($\alpha = .93$) and item correlations ranging from $r = .35$ to $r = .89$. Similar results were reported by Crocker, Bouffard, & Gessaroli (1995) with youth at a sports camp; they reported high internal consistency ($\alpha = .90$) and item correlations ranging from $r = .38$ to $r = .79$. The inductive nature of this study can shed some light on what types of physical activity opportunities youth with visual impairments enjoy or not enjoy physical activity, as we can draw from the experiences of the participants.

Analysis

Data were analyzed using SPSS for Windows v.16 (SPSS Inc., Chicago, IL). Data from the surveys were entered into an Excel (Microsoft, Bellevue, WA) spreadsheet and converted to SPSS with STATtransfer (Circle Systems Inc., Seattle, WA). Scores were totaled by adding up the values from each question on the PACES. Each question can be answered on a score of 1 to 8, with 1 representing the least enjoyment and 8 representing the most enjoyment. The highest score a game could achieve was 144 and the lowest score a game could achieve was 18.

A visual check of histograms and boxplots of the data revealed a nonparametric distribution. Therefore to investigate the differences between groups, a Friedman's ANOVA was employed. Alpha was set at .05.

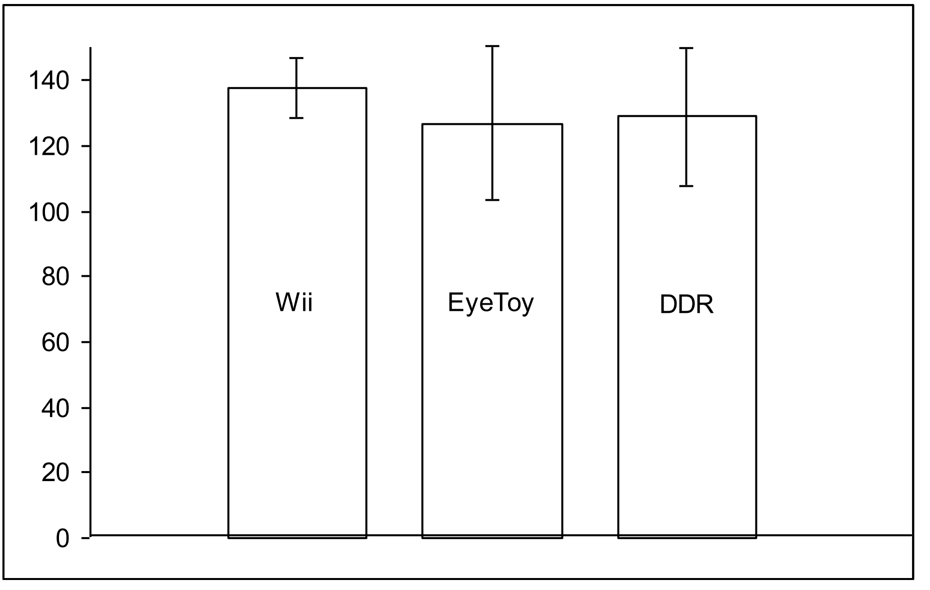

Figure 1. *Mean PACES scores for 1 each game played.*

Results

The findings indicated that there was no significant difference in the enjoyment levels between *DDR* ($M = 129$, $SD = 20.99$), *EyeToy* ($M = 127$, $SD = 23.47$), and *Wii* ($M = 137.67$, $SD = 9.40$), $\chi^2(2) = 3.41$, ns. It is interesting to note that the least variability in scores, as measured by standard deviation, was found after playing *Wii Boxing* ($SD = 9.40$). That is half as much as the 20.99 in *DDR* and 23.47 in *EyeToy*. Overall, the results of this study, as seen in Figure 1, suggest that youths with visual impairments enjoyed being physically active through the use of exergames.

Discussion

The purpose of this study was to measure differences in the physical activity enjoyment levels of youths with visual impairments after playing *DDR* on Playstation 2, *EyeToy Kinetic* on Playstation 2, and *Wii Boxing* on Nintendo Wii. The results showed that there was no significant difference in enjoyment levels of the participants after playing the three different exergames. While *Wii Boxing* had the highest mean score, although not significant, it also had the least amount of variability of enjoyment amongst the participants. High mean scores expressed for all three games indicate a high level of enjoyment for most, if not all participants. A score of 144 is the highest score attainable on the PACES.

Among youth with disabilities, youth with visual impairments are at greatest risk for a sedentary lifestyle (Longmuir & Bar-Or, 2000). Therefore, studies like this are important in furthering the understanding of potential opportunities for physical activity. Taking the enjoyment level of the participants into consideration is essential since it serves as a large motivating factor for children deciding to participate in physical activity and sports (Gill, Gross, & Huddleston, 1983). While there are issues surrounding the dynamic state of enjoyment, the PACES provides researchers with a way to measure the subjective feature. It is important to utilize the PACES in an effort to provide more enjoyable opportunities for physical activity for youths with visual impairments.

Studies have provided evidence that supports the idea that youth without visual impairments enjoy interactive games or exergames (Epstein, Beecher, Graf, & Roemmich, 2007). Epstein's study describes interactive gaming as combining exercise and entertainment and has coined the term "exertainment." The study was able to conclude that children may be motivated to be active if they are given the opportunity to play an interactive video game.

One of the limitations in this study was the small sample size of 12, which may have decreased our ability to detect a significant difference between games if one exists. Also, the participants played these games only at night and only for 10 minutes at a time. It would be interesting to see if enjoyment levels decrease over time. There also was the fact that the participants spent all day being active at a sports camp so they may have already been tired when playing the games. Judging by the scores, we do not think this fatigue played a factor. Regarding the PACES, sometimes the language was not understood by the younger participants and had to be explained by the coaches, this may have affected the validity. Future research in this area should include more participants and research should be conducted over a longer period of time.

This study and others have provided evidence that exergames are enjoyable to the participant playing them (Epstein et al., 2007). Another study using a modified PACES found an enjoyment percentage ranging from 60 to 65 percent among adolescents who played an inactive video game, walked briskly on a treadmill, or jogged on a treadmill (Graves et al., 2010). The enjoyment percentages for the exergames used in this study ranged from 88 to 96 percent among adolescents. The importance of enjoyment in an effort to increase physical activity among children cannot be overlooked. Limited research has been done concerning whether or not exergames, which have a graphic user interface, are enjoyed by youth with visual impairments. However, the consistently high mean scores and the fact that there was no significant difference in the enjoyment levels expressed after playing these three exergames suggests that youth with visual impairments see exergames as an enjoyable way to be physically active.

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Developing a Multi-Sensory Outdoor Education Program

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Abstract

In 1998, there were no outdoor environmental programs or trails specifically for the blind, visually impaired, and multiply-impaired population in central New Jersey. When the Forest Resource Education Center was in the developing phase (1998–1999), none of the original trails were "inclusive" trails. There were no opportunities for these individuals to experience nature, the environment, and the outdoors. There cannot be a relationship to the environment or an appreciation of the environment without experience interacting with it. As a teacher of the visually impaired and a certified orientation and mobility specialist, I consulted with the Forestry staff in the development of the trail. The Sensory Awareness Trail, the physical aspect of the Multi-Sensory Outdoor Education Program, provides a multitude of learning experiences in a safe outdoor environment. Orientation and mobility skills are encouraged and developed best in the natural environment. Independent travel and exploration are integrated into the overall program. The Sensory Awareness Trail also provides for direct contact with natural features of the environment through guided experiences utilizing all of the senses. The Trail has become a success and is available for all ages, developmental levels, and physical abilities, together and barrier-free.

Keywords: basic orientation and mobility concepts, independent travel, inclusive activities, sensory awareness, real-life experiences

The Sensory Awareness Trail was developed at the New Jersey Forest Resource Education Center, located in central New Jersey. The original purpose of developing a sensory trail was to provide visitors of varying abilities with access to the diversified ecology of the New Jersey Pine Barrens. Through the development of interactive, hands-on activities, visitors of all abilities are encouraged to discover, examine, and investigate trees, forests, and the environment.

Some outdoor education programs provide wheelchair accessible buildings and trails, as well as braille and large print signs. However, many outdoor education programs do not use the specific curricula and teaching styles necessary to include visitors who are blind or visually impaired. The uniqueness of this project is not the trail, but the trail in conjunction with a complete environmental education program designed to include all visitors. This holistic approach to sensory awareness combines the physical aspects of trail safety, accessibility, and ease of maintenance with guided multi-sensory forest experiences.

In 1998, an application was made to the National Recreational Trails Act Project, and subsequently a grant for $10,000 was received to initiate the project. The Trails Grant funded the crushed stone, talking trees, and lumber and building materials (Table 1). The trail, consisting of a raised walkway and informational "talking tree" kiosks, was designed as a 1.5-mile loop through an ecologically diverse area. It presents various environmental themes through the use of three informational "talking tree" kiosks and a

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Table 1. Project Grant Budget

Categories	Designated Funds
Lumber and building materials, raised walkway, 3 kiosks, 2 trail signs	$7,500
Self-guided trail brochures	$1,000
Audio equipment	$500
Trail access improvement	$1,000
Total grant	**$10,000**

Table 2. In-Kind Match

Categories	Designated Funds
Planning committee	$2,304
Construction of kiosks, markers, and trails	$7,560
Map development	$1,780
Total in-kind match	**$11,644**

self-guiding brochure. The themes promote forest exploration through sensory awareness using listening, smelling, touching, and tasting activities. For visitors who are blind or visually impaired, a guide rope is also provided. Guided tours provide multisensory lessons along the trail in an outdoor classroom format.

Design

The project design was completed by a team of creative planners of the New Jersey Forest Service staff, members of the Forest Resource Education Center Planning Committee, local school and environmental commission members, and the Project Learning Tree Steering Committee (Table 2).

Labor

The New Jersey forestry staff completed the physical layout and construction of the trail. This included the raised walkways, posts, guide rope, informational kiosks, benches, display table, trail signs, and outdoor classrooms. Volunteers assisted forestry staff with the installation of the interpretive stations and crushed stone trail utilizing scheduled community volunteer events (Table 2).

Key Elements of Finished Project

- Guided tours by New Jersey forestry staff provide lessons at each learning station. "Talking tree" kiosks are used to provide individualized lessons with hands-on experiences (acorns, pinecones, trees, leaves, animal pelts, etc.). Some of the concepts taught include: the sounds of running water and animals; the smell of bark, leaves, berries, and other forest scents; and the feel of the sun, wind, inclines and declines, and soil textures. Tours can be flexible to meet the needs of the group.
- Well-defined, 5-foot wide crushed stone trails are more natural in this environment than asphalt, concrete, or other man-made products. Construction impact on the land was also a major consideration. With asphalt, heavy equipment would be needed, whereas the crushed stone was hand-installed using wheelbarrows. This had minimal impact on the land. Crushed stone is porous and allows for drainage while controlling soil erosion and soil compaction. It compacts sufficiently and provides a stable base for wheelchair users and those with balance issues while minimizing the impact to the forest environment. It provides for a clearly defined path with textured under-footing and auditory/tactual feedback. New Jersey forestry staff members believe that using natural elements such as locust posts and crushed stone protect the natural setting while maximizing accessibility and meeting the needs of visitors. The grade of incline/decline was designed to provide ease and safety in travel.
- Benches in various locations throughout the trail provide for resting and listening areas for outdoor classrooms.
- A 36-inch high cable serves as a guide rope with tactile indicators on the locust posts, which are set every 10 feet along the trail, and with breaks at kiosks and outdoor classrooms. The guide rope is made of 500 feet of plastic coated steel cable. It is a gray color and of

low visual contrast blending into the environment. Originally, a bright yellow 12-strand polyester rope was used to give visual contrast for low vision visitors. This rope was cut and subsequently stolen, so the plastic coated steel cable was installed. Visitors are encouraged to follow the guide rope using the "OK" sign with their hand. Using this technique, the posts and tactual signs can be easily located. Sighted visitors are encouraged to close their eyes as they walk along the guide rope, just as they are encouraged to use their other senses to gain information along the trail.

- All kiosks with "talking trees" are solar powered with an underground cable connection run to the solar panel at the forest's edge, located in sunlight. The wiring and electronic boxes are hidden under the kiosks. The activation buttons are flush against the "tree," minimizing vandalism. There were some problems with squirrels, mice, or chipmunks chewing the wires, so to protect from rodent damage, the electronic equipment has been enclosed in secure wire boxes.
- The multi-sensory curriculum was developed to correspond to New Jersey Core Curriculum Content Standards. Project Learning Tree is an existing environmental education program used throughout the United States, as well as in several other countries. Project Learning Tree activity guide and environmental lessons were correlated to New Jersey State Standards by the New Jersey forestry staff. This team of professionals consisted of foresters, New Jersey State certified teachers, environmental educators, and forest technicians. The diverse group joined together and took basic information from the Project Learning Tree program, adapted it to New Jersey standards, and made it site-specific to the location. Once the Project Learning Tree curriculum was correlated to the New Jersey Core Curriculum Content Standards, specific activities and lessons were chosen for use on the Sensory Trail. The Project Learning Tree curriculum could be adapted by any state to meet its site-specific environmental education needs.

Use of the trail began in 2001 and today, approximately 2,500 children and adults per year are able to enjoy this program, including school groups, families, scouts, and special interest groups. Families of children with visual impairments are encouraged to interact every summer during Family Event Days on the Sensory Trail.

For more information or to schedule reservations for your group, contact:

Forest Resource Education Center
370 East Veterans Hwy
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www.nj.gov/parksandforests/forest

Using Photography as a Means of Engaging Students with Nature

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In my teaching career, I have noticed the increasing disconnect between young people and nature. I am not alone in this observation. On April 22, 2009, both the U.S. Senate and the U.S. House of Representatives introduced versions of the No Child Left Inside bill (H.R. 2054, 2009; S. 866, 2009), a bipartisan effort to close the gap between children and the natural world.

As a member of Environmental Educators of North Carolina (EENC) and the North Carolina Children and Nature Coalition (NCCAN), I have traveled my state, engaging in professional development activities that increase my knowledge and skills in the area of Environmental Education. I then adapt these activities to use with my middle and high school science students at The Governor Morehead School for the Blind.

In the spring of 2010, I participated in a workshop about using nature photography to engage students with the natural world. Inspired by this workshop, I decided to try nature photography with my science students.

As I planned this activity, I had several goals in mind. The first goal was to simply get students outside exploring our beautiful and extensive campus. Once outside, I wanted students to observe nature using all available senses. I planned to use photography as a means to engage the students in an activity that combines orientation & mobility (O&M) skills, visual efficiency, and recreation and leisure skills, with an understanding of the types of organisms that are found around them and how these organisms interact. I also wanted the students to have a product that they could take home and easily share with family and friends.

The first photography outing took place in May 2010. Using my own personal point-and-shoot digital cameras, I took students out, in singles or pairs, for 30 minute sessions. The students who took part in this activity were in grades 5 to 10 (age 12 to 17), and included students with low vision as well as students who are blind. Some students had never held a camera, so I spent some time in the classroom with each group, showing them how to find the front and back of the camera, how to turn on the camera, where to press to take a picture, and what sound the camera makes when a picture is taken. In addition, I gave students some basic photo-taking tips, including telling them to stand at least an arm's length away from an object to take a photo, to consider shooting straight up to capture images of clouds, and to try distance shots as well as close-ups. Students were advised to seek and photograph shape, texture, and contrast to create interesting photos.

Once outside, I used different techniques to engage students with nature. Some students needed to be guided to various natural objects, which they would then explore tactually before taking a picture. A few students had particular types of natural objects in mind (usually trees or flowers) and asked me to help them find them. In these cases, I either provided verbal directions or sighted guide, depending on the O&M skills of the particular student. More independent students, often those with low vision, were allowed to explore freely within a marked area of campus (never out of sight or earshot). Some of the students were very innovative, pointing their cameras in the direction of interesting sounds (such as a bird chirping or the campus fountain), and taking a shot. Some students were excited to discover that they could point the camera straight up at the sky or down at the ground and find nature that way. Some students with low vision were attracted to the bright colors of various flowers, which became the focus of their photos. Other students located flowers by smell, or by the buzzing of insects seeking nectar, and oriented their cameras on the smell or sound. One

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student's photography session took place during a spring rain, and she used the sound of raindrops on puddles or water gushing from gutters as her natural inspiration.

The students produced some stunning photos. Even students who had never before used a camera produced clear shots of amazing composition. Students photographed bugs, flowers, trees, clouds, lichen, soil, grass, and even raindrops falling into puddles. Students with low vision were able to view their photos on a computer screen. Students who were not able to see the photos on the monitor had the photos described to them by me. The three best of each student's photos are proudly displayed in the hallways of our school. Students were also able to take home copies of their best photos to share with friends and family.

Students were asked to write a poem or essay about their experience exploring nature outside. From this collection of writing, I chose one poem entitled "Under the Oak Tree." This poem matched very well with a photograph of oak leaves silhouetted against a cloudy sky. The poem and photo were entered together as a team mixed-media entry in the Environmental Protection Agency's Rachel Carson Sense of Wonder Contest. Our team won 3rd place nationwide in the contest, and we were the only team whose members are visually impaired or blind.

After the photography activity I asked students about their experience. All stated that it was fun, and that they had learned a lot about the natural world while engaged in the photography. Students were able to relate the photos that they took to other sensory information, such as sounds, textures, or smells. Students also stated that they enjoyed visiting parts of the campus that they do not usually get to travel. My students ask often to go outside and take photos, and we have done so several times. These experiences have increased their skills in O&M, recreation and leisure, and visual efficiency, as well as increased their connection to the natural world. I encourage other teachers of the visually impaired to try using photography to engage their students in learning about nature.

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Review: *Sites Unseen*

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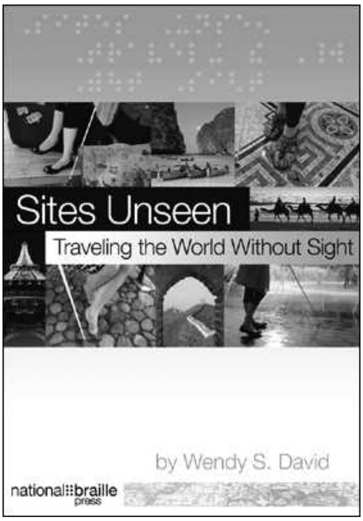
Sites Unseen: Traveling the World without Sight by Wendy S. David. (2010). Braille. ISBN: 978-0-939173-69-3. US$ 19.95. Boston, MA: National Braille Press.



Description

Sites Unseen is an all-inclusive travel guide written from the viewpoint of an experienced traveler with vision loss. Detailing the many intricacies of domestic and foreign travel, this book outlines the entire travel process for readers who are visually impaired ranging in comfort level from the rigidly independent to those preferring assistance *en route*. Unlike most travel guides however, this book is saturated with humorous anecdotes and is truly a joy to read from cover to cover. The author writes in a style that gives the reader a sense that they are a companion traveler on one of her many adventures.

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Purpose

To engage novice travelers in a "how to" conversation regarding successful travel. Topics include selecting a destination, navigating the travel scene (e.g., plane, train, and cruise ship), establishing lodging accommodations to suit a range of assistance needs, considerations for dog guide users, adaptive resources, preparation for travel, and ensuring a safe travel experience.

Audience

Although intended for readers who are visually impaired, this resource is rich with information pertaining to wheelchair users, service dog users, and novice travelers in general.

Features

The guide is available in a number of formats, including print, braille, eBraille, and DAISY, and features a rich body of resources. A travel aficionado herself, the author describes her encounters with various travel agencies, airlines, cruise companies, and hotels, outlining their level of accessibility and accommodation, both for herself and her dog guide. Aside from the table of contents (which is difficult to decipher due to the creative chapter titles), the book is well organized and is written in the progressive stages one would likely follow when planning a trip.

Beginning with Chapters 1–4, the reader is presented with detailed insight with regard to travel planning and selecting a destination. An abundant list of on- and off-line travel resources is presented to help guide readers in making a destination decision that truly suits their preferences in terms of accessibility, level of accommodation, and adventure. The contextual detail is remarkable, as the author goes so far as to offer unconventional tips to overcome the obstacles of navigating in a new (and potentially foreign) environment. Considerations for individuals traveling alone,

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with a sighted guide or visually impaired travel partner, or as a part of a tour group are also presented.

Chapters 5–7 discuss various modes of travel, including journeying by bus, plane, or train. For the reader desiring sea legs, Chapter 9 provides a detailed account of vacationing by cruise ship. In addition to providing summated lists of accessible cruise, air, bus, and train lines, the pros and cons of each mode are considered relative to the travelers with dog guides. As with the early chapters, the author provides recommendations with uncanny detail, discussing methods to navigate a bus station, identifying factors to consider when booking a sleeper cabin on a train, and providing tips for efficiently negotiating airline security screenings with a dog guide. These discussions converge in Chapter 8, almost as if readers have just arrived at their destinations, with an in-depth outline of the ''many flavors'' of the hotel industry.

Through the remaining chapters, the novice traveler is provided with recommendations for packing (both for the traveler *and* an accompanying dog guide), utilizing GPS for efficient navigation, minimizing safety concerns throughout the travel experience. Readers are also provided with a ''top ten'' list of factors that should be considered prior to traveling abroad. The book concludes with a list of national and international agencies specializing in travel and adventure opportunities for individuals with disabilities, contacts for adaptive recreational pursuits, and a compilation of social travel networks.

Due to the extensive detail and the pleasant writing style of this text, *Sites Unseen* has the potential to serve as a leading resource for accessible travel and recreation. Although intended for readers with vision loss, the comprehensive list of resources tailors to a wider audience, thereby increasing the potential readership to include wheelchair and service dog users, regardless of visual status. No matter the destination, *Sites Unseen* successfully equips readers to travel confidently, and with the level of independence they desire.

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