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UNDERSTANDING PHYSICAL ACTIVITY MOTIVATION AND ACTIVITY MONITORING DEVICE PREFERENCES FOR YOUTH WITH VISUAL IMPAIRMENTS: A PILOT STUDY

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by

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ABSTRACT

Background: Previous research demonstrates that individuals with visual impairments (VI) are at risk for health-related illnesses attributed to inactivity and low fitness. As patterns of behavior—such as physical activity (PA)—established during childhood and adolescence determine one's risk of developing chronic disease and illness later in life, this is a crucial time of life in which to target motivation and maintenance of a physically active lifestyle. Few studies have examined the use of PA monitoring devices on PA motivation in general, particularly in children, adolescents, or individuals with VI. The purpose of this study was to determine the possible motivational factors of two popular fitness bands and one talking pedometer on the PA motivation of youth with VI, and whether these factors differ based upon sex or VI level.

Methods: Participants consisted of 20 youth (13 males, 7 females, M_{age}=12.65±2.26) with VI. During a weeklong developmental sports camp for youth with VI, participants were placed in groups of 5 and given the two fitness bands and talking pedometer to wear concurrently. Focus groups were conducted at the end of each day; the sessions were recorded and transcribed. Participants responded to questions based on the social-ecological model (SEM) to discern, relative to these exercise devices, various motivators for PA at the intrapersonal, interpersonal, and organizational levels, including: ease of use and access to data, understanding of the data, device preference, interpersonal benefits of using these devices, specific aspects of the devices that were found to be motivating, and suggested changes to the devices. Two researchers

developed a coding scheme within an SEM framework using standard qualitative methods and coded responses by VI level, perceived motivation for PA, favorite device, and motivating device components; once consensus was reached, coding was analyzed using NVivo 10.

Results: Results included the perceived motivational benefit of using these devices, the variance of device preference based upon VI level and the lack of variance based upon sex, such as a preference for the audible device by those with less vision, and different aspects of each device on three SEM levels that the participants found to be motivating, such as the type of PA measures displayed, the incentive they offered to compete with peers or set PA competition goals, and ways in which the devices could be utilized at the organizational level to improve PA motivation for these participants.

Conclusion: Overall, all three PA-monitoring devices were reported to increase the participants' motivation for PA. Device preference did differ by VI level, with those with less sight preferring the auditory device and those with more sight preferring the Nike Fuelband, which had the best visual contrast. All three devices also had aspects that were found to be motivating at the intrapersonal, interpersonal, and organizational levels of the SEM framework, such as the feedback and encouragement they offered, the ability they gave to compete or set goals with peers, and their ability to be used in school physical education classes. In future, the specific motivational aspects of these three devices may be used by PA interventions to increase the PA of this population and decrease rates of chronic illness related to sedentary lifestyle.

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CHAPTER 1

Introduction

Physical activity (PA) has been shown to have many protective health benefits. Defined as any "movement of the human body that results in expenditure of energy at a level above the resting metabolic rate" (Anshel et al., 1991, p. 113), PA conveys physical, social, and psychological benefits. These benefits include: reduced risk of heart disease, stroke, type II diabetes, high blood pressure, high cholesterol, some cancers (colon, breast, etc.), depression, and premature death; decreased stress; favorable body composition, prevention of weight gain, weight loss—particularly when combined with reduced calorie intake—weight maintenance after weight loss; improved bone health; and improved cardiovascular and muscular fitness (USDHHS, 2008; Surgeon General, 1996). PA may be used to achieve the four central goals of Healthy People 2020 (USDHHS, 2010b):

1. Attain high-quality, longer lives free of preventable disease, disability, injury, and premature death
2. Achieve health equity, eliminate disparities, and improve the health of all groups
3. Create social and physical environments that promote good health for all
4. Promote quality of life, healthy development, and healthy behaviors across all life stages

However, not all Americans have sufficient PA motivation, self-confidence, or support and therefore do not experience all of these factors related to a high quality of life and health

equity (Capella-McDonnall, 2007). Individuals with disabilities are one such population and are the focus of the Disability and Health topic of Healthy People 2020; objectives for this population incorporate inclusion in public health activities, reception of interventions, interaction with their environments without confronting barriers, and participation in activities of everyday life (USDHHS, 2010a). PA interventions directed toward individuals with disabilities would address both these objectives and the four goals of Healthy People 2020.

Those individuals with visual impairments (VI) are an oft-overlooked sub-group in this population that are in great need of PA interventions in order to enjoy the health benefits associated with levels of PA that are recommended for our healthy population as a whole. Previous studies and National Health and Nutritional Examination Survey data demonstrate that those with VI are at a higher risk than sighted individuals for health-related illnesses and a compromised quality of life attributed to inactivity and low fitness (Lieberman, Byrne, Mattern, Watt, & Fernandez-Vivo, 2010; Willis, Jefferys, Vitale, & Ramulu, 2012). Just as with adolescents of the general population, individuals with VI begin to experience this sharp decline in PA during adolescent years (Fakhouri et al., 2012; Kozub & Oh, 2004).

Low PA levels and the resulting PA-related illnesses are ongoing problems constantly faced by individuals with VI, especially beginning during adolescent years, and there is a need for research that informs interventions specifically targeting the PA levels of this minority population. The purpose of this study was to examine factors related to PA motivation for youth with VI through their use of PA-monitoring devices. Preferred PA motivating device, VI level, and helpful device components were examined. Qualitative methods were used to answer the following questions regarding various factors relating to PA motivation for youth with VI to inform future interventions. For this study, the research questions addressing these aims are:

1. Do youth with VI find PA monitoring devices motivating?
2. Does preference for PA monitoring device vary by sex or VI level (for example, blind B1 level versus B2 and B3 who have some vision) among youth?
3. What specific aspects of PA monitoring devices do youth with VI find motivating?

Review of the Literature

This review will discuss the literature relevant to the current study of PA motivation for youth with VI, including PA-related health disparities in youth with VI, barriers to PA for this population, previous interventions, and the purpose of the study.

Physical Activity-Related Health Disparities in a Visually Impaired Population

Almost two decades ago, VI was defined as "a significant limitation of visual capability resulting from disease, trauma, or congenital condition that cannot be fully ameliorated by standard refractive correction, medication, or surgery" (Arditi & Rosenthal, 1998). Though youth with VI make up only about one percent of our population, this still represents a significant number of individuals at risk for low physical activity (The Employment and Disability Institute of Cornell University, 2013). According to a recent study by Cornell University, there were about 659,700 individuals up to the age of 20 in the U.S. who reported having a VI, including all ethnicities and education levels (The Employment and Disability Institute of Cornell University, 2013). Results from the 2013 American Community Survey show that for those under the age of 18, 557,236 individuals in the U.S. reported having vision difficulty (U.S. Census Bureau, 2013).

However, these large numbers of youth with VI experience high rates of physical inactivity and are not adopting beneficial PA behavioral patterns to the extent that they should for a healthy quality of life. Recent research has shown that those with VI participate in fewer activities than their sighted peers (Greguol, Gobbi, & Carraro, 2014; Kozub & Oh, 2004; Kroksmark & Nordell, 2001; Lieberman & McHugh, 2001; Longmuir & Bar-Or, 2000). According to a qualitative study on leisure time PA, adolescents with low vision were less active, did not spend as much time with their friends, and were even more dependent on their parents for transportation than were their sighted peers (Kroksmark & Nordell, 2001). Additionally, in a study conducted on 41 Brazilian and Italian youth with VI, participants were administered the Physical Activity Questionnaire for Children, the Offer Self-Image Questionnaire, and a questionnaire on disability, body weight, and height; significant correlations were detected between BMI, body image, and PA— with more active participants, BMI values were lower and body image was perceived as better, and with both increasing blindness and age, activity levels decreased, which may lead to higher BMI and more negatively perceived body image (Greguol et al., 2014). In addition, Longmuir and Bar-Or (2000) examined the gender, disability type, age, habitual PA levels, perceived fitness, and perceived PA limitations on 458 girls and 499 boys through the use of a mailed survey and found that those youth with VI were some of those with the most sedentary lifestyles. In 2001, Lieberman and McHugh found that of the 46 youth with VI that took a Fitnessgram health-related fitness test, fewer than 20% of those with VI passed more than three items of the test, compared to the majority of the sighted youth who took it. In another study examining VI level (broken down into “high vision,” “low vision,” and “totally blind,” descriptors used at school) and age on PA levels, Kozub and Oh (2004) placed accelerometers on 19 youth from a Midwestern school for the blind for four days and found that

their bouts of moderate to vigorous PA (MVPA) were significantly lower than a similar study of sighted peers and that age was inversely related to PA levels. These significantly lower levels of PA and high amounts of sedentariness are concerning because, as stated by the National Research Council and Institute of Medicine, "The behavioral patterns established during these developmental periods help determine young people's current health status and their risk for developing chronic diseases in adulthood" (National Research Council and Institute of Medicine. Committee on Adolescent Health Care Services and Models of Care for Treatment, 2009).

As a result of decreased PA levels in this young population, youth with VI on average have higher rates of obesity and chronic illnesses than the overall population. In his textbook on lifetime adapted PA, Sherrill (Sherrill, 1998) found that students with VI do not attain the same physical, psychological, and social benefits as their sighted peers. Those with such disabilities have significantly higher rates of obesity, which can lead to medical conditions, negative psychological and social effects, and increased medical costs (Rimmer & Wang, 2005; Weil et al., 2002). Individuals with VI overall were found to have higher levels of body fat and lower levels of balance, cardiovascular endurance, muscular endurance, and muscular strength than their sighted peers and can become dependent on others in order to navigate (Jankowski & Evans, 1981; Lieberman & Carron, 1998; Skaggs & Hopper, 1996). This increased sedentism was also found to have negative psychological and social effects, such as negative affect, anxiety, depression, low self-esteem, low confidence, and poor self-efficacy (Morgan, 1994). In general, those with VI do not enjoy as many protective health benefits of PA as their sighted peers and experience many PA-related health issues (Lieberman, Byrne, Mattern, Watt, & Fernandez-Vivo, 2010; Willis, Jefferys, Vitale, & Ramulu, 2012). As PA levels in this population have been found to be inversely correlated with age, and behavioral patterns begun

during developmental years can affect an individual for life, childhood and adolescence are important life stages to target for increased PA for life.

Studies have found that even within these early years, PA levels begin to drop off. MVPA levels in this population were found to be inversely correlated with age, and older adolescents with VI are even less active than their younger counterparts (Ayvazoglu, Oh, & Kozub, 2006; Kozub & Oh, 2004; Oh, Ozturk, & Kozub, 2004). In Kozub and Oh's 2004 study of the PA levels of 19 children and adolescent students aged 6-18, adolescents with VI were found to select inactive options more often during their leisure time. Even in structured environs, students with VI in grade school physical education (PE) were found not to participate in vigorous PA as often as their sighted peers (Lieberman & McHugh, 2001). However, research clearly shows that adolescents with VI are just as able to perform motor tasks as their sighted peers, and those who partake in daily PA are able to obtain similar fitness levels as well (Blessing, 1993; Gleser et al., 1992; Norris, 1957; Ponchillia, Powell, Felski, & Nicklawski, 1992). In 1986, Hanna pressed for PA and health promotion interventions for those who are VI (Hanna, 1986); this call has been echoed in recent times, especially by Capella-McDonnall (2007), who cited the lack of attention that those with VI receive for health and PA promotion programs. There is a growing need for the use of this research in practice; after 30 years, not much has improved still for this oft-overlooked minority population, and health disparities between people with and without VI continue to exist. If PA levels begin to decline as early as adolescence and PA levels of visually impaired adolescents are lower even than those of their sighted peers, then this is the population that should be targeted for national PA interventions. The first step for such interventions is to identify barriers to PA in youth with VI.

Barriers to Physical Activity in Youth with Visual Impairments

Bronfenbrenner's Social-Ecological Model (SEM) as adapted to the PA sphere is a relevant and useful way to address multi-level barriers to PA in this population and create a holistic framework to increase PA. This model focuses on the "progressive accommodation" between an individual, throughout his life span, and his changing immediate and social environments and takes into account factors at the intrapersonal, interpersonal, institutional or organizational, community, and policy levels (Bronfenbrenner, 1977; Sallis, Bauman, & Pratt, 1998). Many of the main barriers to PA that youth with VI confront fall into the intrapersonal, interpersonal, and organizational levels.

The most common barrier to PA for adolescents with VI is an intrinsic lack of motivation. In a study of 31 students aged 12-21 in afterschool programs at a residential school for the visually impaired, youth with VI who were at a healthy body weight and participated in recommended amounts of daily PA were shown to have greater intrinsic motivation as opposed to their less healthy and less active peers with VI (Kozub, 2006; Saebu & Sørensen, 2011). Taking previous research into account, it seems necessary to examine the effects of sex and VI level on intrinsic PA motivation in this population. Previous studies have found that, in the general population, girls tend to be less physically active and less motivated for PA than boys (Sallis, et al., 1998; Troiano et al., 2008). With this in mind, it is crucial to discern if there is a difference in motivation style based on one's sex that would be effective in motivating PA in an individual with a VI. In terms of VI level, little to no research has been done in this area as a way to discern extent of VI and the subsequent effects on motivational techniques. Previous research has found that lack of self-confidence may relate to VI level and that with decreasing vision, frustration related to task achievement in PE increases (Culp & Bernacchi, 2009; Stuart,

1998; Tepfer, 1998). In a 2012 study of 30 boarding school youth with VI—16 with low vision and 14 with legal blindness—a PA diary and one mile run/walk test were used to determine the effects of sex and VI level on PA; it was found that youth with VI did not participate in vigorous PA, only in of moderate and light PA, and that sex affected PA in low vision participants, specifically finding that girls were significantly less active than boys (Aslan, Calik, & Kitiş, 2012). Taking this into account, it seems important to individually tailor PA motivation based on VI level.

Locke and Latham's Goal-Setting Theory is extremely useful in this instance, as it identifies several key components in effectively setting and achieving goals, especially as they relate to PA motivation and PA levels (Locke & Latham, 2006). They outline that goals relating to PA should be challenging but realistic; in addition, these goals should be specific, and exercisers should gain feedback on their progress. To utilize this theory, goal-setting techniques aligned with the acronym SMARTER may be employed in PA interventions for this population; in a recent article by Mantell, long-term maintenance of a PA behavior and improved wellbeing can be attained with this technique, in which he outlines that PA interventions should include personal goals that are specific, measureable, attainable, realistic, timely, developed enthusiastically, and attached to rewards (Mantell, 2012). Likewise, Karageorghis and Terry (2011) stressed that ways to promote intrinsic motivation are goal-setting, planning and charting progress, and positive self-talk. A similar goal-setting theory that fits well with the overarching SEM framework and that has been used to successfully increase motivation for PA is the Social Cognitive Theory (SCT).

The SCT is based on principles of social learning first developed by Bandura (Bandura, 1986) and explains how personal, behavioral, and environmental factors interplay to influence

each other and to create human behavior; in relation to exercise psychology, behavior change (e.g., increased PA motivation and PA levels) is largely affected by increasing self-efficacy and using self-regulation techniques (McAlister, Perry, & Parcel, 2008). Self-efficacy regards a person's beliefs about his individual ability to perform and accomplish behaviors that bring about a desired outcome. In relation to this study, self-efficacy may refer to a participant's belief that he or she can accomplish a specific activity or a set level of daily PA. Furthermore, self-efficacy may be increased through verbal or technological persuasion (e.g., encouragement, whether spoken or technological, to boost one's activity-related self-confidence) and mastery experience, the achievement of success through realistic yet increasingly challenging behaviors. Self-regulation techniques employed by the SCT include managing one's behavior through the use of self-monitoring, goal-setting, feedback, self-reward, and, on a more intrapersonal level, social support. Self-monitoring involves the observation and recording of one's behavior and the cues accompanying the behavior. Goal-setting, in terms of the SCT, is a planned behavior that is gradually achieved through the setting of both long-and-short-term goals. Feedback is gathered about the quality and quantity of the behavior, both from one's own self-examination and from external observation or report. Finally, intrapersonal motivation can be improved through the use of short-term, regular self-reward with the accomplishment of both short-and-long-term goals (McAlister, Perry, & Parcel, 2008, p. 169-185).

In addition to intrapersonal motivation, this population also experiences a lack of interpersonal or social motivation for PA. The SCT may be drawn upon to improve motivation at this level through the use of social support. This is achieved through verbal persuasion by friends, family, and authority figures; reception of feedback; and action cues (McAlister, Perry, & Parcel, 2008, p. 169-185). All of these types of social support are often used during peer

interaction or play, which often occurs in schools and school PE. However, youth with VI often experience barriers to PA motivation at the social level, especially in school.

A recent study sites a lack of inclusion in schools in which those with VI can "interact with, learn from, and form friendships with peers" (Hodge & Lieberman, 2012). In interviews of students with disabilities, Bredahl found that if those students experienced skill-related difficulties related to their disabilities, they felt feelings of embarrassment, incompetence, and inadequacy based on perceived social judgment (Bredahl, 2013). In addition, students' feelings of acceptance, respect, and competence are largely affected by the beliefs of their peers without disabilities (André, 2013; Asbjørnslett & Hemmingsson, 2008; Obrusnikova, 2010). A major factor which students with disabilities associate with negative experiences by students without disabilities is not spending interaction time together in or out of school (Kalymon, Gettinger, & Hanley-Maxwell, 2008; Seymour, Reid, & Bloom, 2009). However, the majority of middle school PE students without disabilities regards playing with peers with disabilities as positive and has strong intentions to play with their peers with disabilities (Campos, 2014). In order to address this discrepancy and increase social motivation for PA, inclusion in schools should be fostered in order for youth with and without VI to form friendships and promote understanding, group goal-setting, competition, and learning.

Finally, motivation for PA at the organizational level is very limited. Physical education (PE) is the main opportunity in schools for youth to be active and interact socially, but for those with VI, adapted PE is a rare opportunity, and not all PE teachers feel confident in their abilities to adapt their programs for youth with VI. Citing this lack of adapted PE opportunities, Lieberman and Houston-Wilson called for the creation of a program within general PE for those with VI that can be personalized in terms of goal-setting and accommodations (Lieberman &

Houston-Wilson, 2009). Later studies have shown that the opportunity to participate in adapted PE in schools is a rare one for many adolescents with VI, as not all have the advantage of PA programs that meet their needs in schools (Conroy, 2012; Perkins, Columna, Lieberman, & Bailey, 2013). General PE teachers have been found not to be opposed to such inclusion, but in general they lack training and preparation in inclusion techniques and do not deem their training adequate, and as a result of this widespread lack of competence and knowledge, those with disabilities remain "functionally excluded" and lack greater social interaction. A greater emphasis is needed on special needs education and inclusion for PE teachers, but key barriers to inclusion remain: a limited access to resources and equipment, game-dominated PE, better development of individual education plans are still needed, lack of input by PE teachers, and the training of special needs aids in inclusion of student with disabilities in PE classes (Lieberman & Houston-Wilson, 2009).

Taking these many levels of PA motivation barriers into account, a simple way to address these barriers is needed. A generalizable, personal, interactive, and large-scale way to utilize these strategies for increasing PA motivation in this population is through the use of PA monitoring devices that give individually-tailored, personal feedback and encouragement along the lines of the SCT and Goal-Setting Theory, allow for social interaction and competition, and may be used in more adapted PE settings as a way to set personal daily goals and be incorporated into one's individualized education plan.

Previous Interventions

Recent studies have examined the use of PA monitoring devices in order to increase motivation for PA on various levels. Most of these studies involve participants with no VI or adults with VI in certain settings (such as rehab settings, in consumer groups, and community-

based lifestyle trainings), while a select few are conducted among a general sample with VI (Capella-McDonnall, 2007). One such study has found that sensory approaches help motivate youth with VI to increase activity levels, and the use of PA monitoring devices would be an efficient, cost-effective way to do this (Lieberman, Ponchillia, & Ponchillia, 2013). In a four-week field study with 23 sighted participants, Munson and Consolvo (2012) employed a mobile phone application which they created to discern how goal-setting, rewards, self-monitoring, and sharing could help increase PA motivation; participants found it helpful to have primary and secondary weekly goals, be given non-judgmental reminders, and be able to post results onto their Facebook pages. In a more all-encompassing empirical review summarizing 35 years of research on general goal-setting theory, Locke and Latham (2002) found that the most effective goals are those that are self-set, realistic, trackable, and include positive feedback. In a meta-analysis of behavior change interventions for PA, Michie and colleagues (2009) concluded that self-monitoring, whether in the forms of self-set goals, assigned goals, or simple reflection, is a significant and effective part of PA interventions, especially when combined with at least one other goal-setting technique. Finally, the HopeLab, funded by the Robert Wood Johnson Foundation (2012), recently released results of their study on the Zamzee wearable activity meter, a tri-axial accelerometer device that clips onto the participant's clothes and pairs with a rewards website; for the 448 sighted adolescent participants over the span of six months, the Zamzee showed an average increase of 59% PA compared to the control group, and the device also led to significant increases in PA across multiple groups at risk for physical inactivity. While these recent studies have seemed to be effective in promoting PA motivation in the general population, VI level is a more complicated intrinsic factor to address, as there is a lack of research on the topic.

There is limited research on VI level and various PA monitoring devices or PA motivation and promotion. A literature review of 28 studies of PA measurement for those with disabilities revealed that most PA monitors were used to assess or measure PA in this population but not to promote it (Cervantes & Porretta, 2010). Two recent studies however, have explored the effectiveness of PA promotion on adolescents with VI, using talking pedometers and the Nike Fuelband (Nike, Beaverton, OR). In 2006, an examination of talking pedometers on the walking behavior of 22 youth with VI or deaf-blindness(15 boys, 7 girls, age range 9-13, with varying levels of VI) at a summer sports camp for the visually impaired, participants were motivated by talking pedometers feedback to set challenging personal goals for raising daily PA levels and friendly competition, increase their health and fitness, and increase their independence gained from walking, which was also viewed positively as a form of independent transportation (Lieberman, Stuart, Hand, & Robinson, 2006). While the use of talking pedometers seemed successful in promoting PA motivation in this population, there are many other more modern PA monitoring devices currently on the market that could be of use, the Nike Fuelband being on of the more popular and recognized of them.

In regard to the second recent study, 2014 marked the third consecutive year of the National Fitness Challenge, funded by the WellPoint Foundation's grant to the U.S. Association for Blind Athletes (USABA) (Business Wire, 2014). This challenge took place from February to November of 2014 and gifted more than 800 individuals with VI in 25 states with a Nike Fuelband. These participants were aged 15-40 and required daily access to a computer and iPhone; they also were trained in the daily use of the Fuelband and in the social media connected with it. Additional components of the program included goal-setting, monthly fitness activities, the implementation of a team environment, and opportunities for leadership experience in order

to increase PA (to the level set by the Centers for Disease Control and Prevention), health, fitness, and health-related quality of life. In a statement by Pam Kehaly, president of WellPoint's Specialty business, Commercial Strategy and West Region, "The WellPoint Foundation helps us continue meeting the company's commitment to helping children and adults live active lives and avoid the health risks associated with sedentary lifestyles and obesity. We believe no one should be denied the right to enjoy the physical and emotional benefits associated with exercise; therefore, we are very proud to once again partner with the USABA to ensure that vision impairments do not limit the recreational opportunities afforded to people across the country." Though this is the only study to date involving the Nike Fuelband for increasing PA motivation and PA levels of VI participants, no additional data has yet been released on the quantitative results of this three-year initiative.

Purpose of the Study

There are very few studies involving PA monitoring devices as a way to increase daily PA motivation for youth with VI, and more research is needed, especially looking through the framework of the SEM, as it is a proven way to elicit behavior change (Sallis, Bauman, & Pratt, 1998). At the intrapersonal level, VI level, sex, self-efficacy, and SCT and goal-setting theory techniques should be targeted as a way to increase PA levels. At the interpersonal level, competition, goal-setting, social support, and the ability to engage with family and friends anytime and anywhere are potential aspects of these devices that may be called upon to create this behavior change. Lastly, at the organizational level, community engagement—in the form of a more adapted, personalized form of PE and the integration of this program into one's individualized education plan—should be incorporated as well.

In addition, there are no studies specifically tailored to increasing PA motivation based on VI level or sex. Disregarding VI level and sex, previous studies have used many established strategies for enhancing intrinsic motivation for PA, such as goal-setting, planning and charting progress, self-monitoring, positive self-talk, and the SMARTER strategy of forming goals that are specific, measureable, attainable, realistic, timely, developed enthusiastically, and attached to rewards (Karageorghis & Terry, 2011; Mantell, 2012). PA monitoring devices are useful tools that can help participants utilize these many strategies for increasing PA motivation on a personally-tailored basis, using the SEM and taking into account the participant's VI level and sex as well.

In conclusion, adolescence is a critical period during which it is extremely important to maintain PA levels and a healthy lifestyle. Youth with VI are an especially at-risk population for physical inactivity and physical inactivity-related health issues; they may be less motivated to participate in PA and less healthy overall than their sighted peers. Few studies have examined the use of PA monitoring devices on PA motivation in general, particularly in adolescents with VI, and no studies have included tailoring of the devices to sex and/or VI level along with effective strategies to enhance PA motivation. There is a need for research that personally tailors PA monitoring devices and motivational strategies involved with them in order to examine the effects of sex, VI level, and PA motivation on PA level.

The purpose of this study was to examine factors related to PA motivation for youth with VI through their use of PA-monitoring devices. VI level and specific device components were examined as well to determine if there was a relationship between VI level and device preference and VI level and helpful device components. These PA motivation strategies should be at each participant's own pace to create a personalized and independent promotion and maintenance of

PA across his or her lifetime. The strategies should include aspects of the Goal-Setting theory, SCT (e.g., components of self-efficacy, self-regulation, and social support), SMARTER goal-setting, planning and charting progress, and positive self-talk. PA monitoring devices contain have a constant display and give frequent feedback, in order to make use of SCT and SMARTER goal-setting strategies. Currently, the most common and affordable of these devices include the Nike Fuelband (Nike, Beaverton, OR), Garmin Vivofit (Garmin, Lenexa, KS), and Centrios talking pedometer (Orbyx Electronics, LLC, Walnut, CA). These devices all have a constant display and various ways of presenting differing amounts of PA data (see Table 1).

Findings from this study could inform future interventions aimed at overcoming barriers to PA and increasing the PA of specific VI populations and may be utilized to mass-target PA motivation and PA levels in this minority population and increase the health and quality of life of at-risk individuals. In future, results of this study may be used by the companies creating these PA monitoring devices in order to create devices that may be used to help increase the PA and overall health of a larger proportion of the general population.

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CHAPTER 2

Methods

Research Design

This study's research design was cross-sectional and descriptive. Dependent variables were device preference and perceived change in PA motivation. Independent variables were VI level and sex. The participants for this study were youth with VI recruited from a summer sports camp for youth with VI.

Sample and Recruitment of Participants

Because of time and financial constraints, participants consisted of 20 youth with VI from across New York State. They were drawn from Camp Abilities, a week-long developmental sports camp for youth with VI, which is held annually at SUNY Brockport. The participants were 20 youth (13 males, 7 females, M_{age} = 12.65±2.26) with VI, aged nine to twenty, with multiple levels of VI represented. Participants were entered into the study once consent and demographic forms were received. This study was approved by the Institutional Review Board (IRB) at SUNY Brockport and was determined a dataset by the Pennsylvania State University IRB and therefore not human subject research.

Procedures

Beginning with the first day of the camp, each study participant was randomly placed in one of four groups, each with five participants; on each day for four days, a different group's participants were all assigned to wear the Nike Fuelband, Garmin Vivofit, and Centrios talking

pedometer all at once. The devices were to be placed on the side of the body opposite any aid, such as a cane or a sighted individual's arm. If no aid was needed, participants wore the devices on the non-dominant side, for example the non-dominant wrist for the Fuelband and Vivofit and the non-dominant hip for the talking pedometer. Though the B1 participants were not able to see the devices, they could gain audible feedback from the talking pedometer and get feedback from the Fuelband and Vivofit by asking their peers or by linking the devices to their phones via Bluetooth or taking pictures of the data screens and having their phones read the output back to them, a practice which many of them perform on a daily basis in order to gain information from their surroundings.

The Nike Fuelband is a wrist-worn accelerometer device that brightly displays on a black screen "Fuel," steps, time, calories, and whether one's goal is reached, during which a bright rainbow band flashes across the bottom. The Garmin Vivofit is also a wrist-worn accelerometer device which more dimly displays on a black screen time, date, steps, miles, and calories. The Centrios talking pedometer is a device that clips onto the hip and displays in black numbers on a gray screen and voices aloud—either automatically or at the push of a button—steps, time elapsed, and calories. The fitness devices and their values are displayed in Table 1.

Participants took part in a nightly focus group, which included proctored questions (see Table 2) to each participant as part of a verbal survey (questions 1, 2, and 4 of Table 2) based upon the Social-Ecological Model (as adapted to the physical activity sphere) and using the focus group goals of needs assessment and product development (Bronfenbrenner, 1977; Sallis, Bauman, & Pratt, 1998; Krueger & Casey, 2000). Questions were tailored in order to gain feedback and preferences for each device, discern whether they found that the device motivated them to be more active, and specific aspects of the preferred devices that were found to be

motivating by the participants. Additional questions asked in the groups related to the participants' familiarity with the devices, ease of use and access to data, understanding of the data, interpersonal benefits of using these devices, and suggested changes to the devices. Many of these questions were "yes or no" based, and additional contextual information was gained by delving more deeply and asking responders to explain their reasoning and to give examples. These focus groups were recorded, transcribed verbatim with identifying information removed and then imported into NVivo 10 (QSR International, Burlington, VT).

Measures

Each participant was coded by VI level, sex, preferred device, and perceived motivation. This data was drawn from the study's demographic forms and verbal survey answers from focus group transcripts. Relevant questions from the focus groups may be found in Table 2.

VI levels, as tested by optometrists, were labeled as B1, B2, and B3, which are the medical-based classifications used for Paralympic sport, outlined as follows and in Table 3 (IBSF, 2014). Classifications were partly based on LogMAR scores from the visual acuity eye chart, with 20/20 vision classified as LogMAR 0.00. VI levels range from B1 (lowest level of vision) to B3 (highest level of vision for those still classified as VI). B1 individuals are those whose visual acuity is poorer than LogMAR 2.60; B2 have visual acuity ranging from LogMAR 1.50 to 2.60 (inclusive) and/or Visual field constricted to a diameter of less than 10 degrees; and B3 include visual acuity ranging from LogMAR 1.40 to 1 (inclusive) and/or Visual field constricted to a diameter of less than 40 degrees (IBSF, 2014).

Sex was divided into a male and a female category, with the definition based upon reproductive features and not behavioral, cultural, or psychological traits. Preferred device

conveyed which of the three PA monitoring devices—Fuelband, Vivofit, or talking pedometer—each participant liked best, as discussed in the focus groups as part of the verbal survey. Perceived change in PA conveyed whether each individual believed, based upon his/her use of the devices, whether they believed their preferred device would increase their daily PA motivation levels or not, as discussed in the focus groups.

Data Analytic Plan

The principle investigator and a trained research technician developed a coding scheme based on the Social-Ecological Model. Responses for preferred device and perceived PA motivation based on device use were coded based on intrapersonal, interpersonal, and organizational factors, such as the auditory component of the talking pedometer, increased socialization with peers, and whether participants had worn one of the devices for school before. The researchers kept observer comments during the focus groups, and general data themes within the SEM framework were developed during and after data collection. Outlined data patterns were made into thematic categories for a focus group data coding tree. The investigators independently coded the transcripts with the coding tree to identify major themes around VI level, sex, preferred device, and perceived PA motivation (see Appendix G for the focus group coding tree). The coders met to discuss the codes and came to consensus, using a process of triangulation. Data was analyzed using NVivo 10. Each participant was coded by VI level, sex, preferred device, and PA motivation response (“yes”/”no”), and preferred device and PA motivation were qualitatively analyzed according to VI level and sex. Trends by sex and by VI level (blind B1 level versus partially sighted, grouped B2 and B3 levels) were examined.

Table 1
Devices Used

Devices		
Nike Fuelband	Garmin Vivofit	Centrios Talking Pedometer
		
Data Displayed		
• "Fuel" • Steps • Time • Calories • "Goal"	• Time • Date • Steps • Miles • Calories • Activity strip	• Steps • Time elapsed • Calories burned • Can announce automatically or by pressing the "Talk" button

Sources.
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Garmin. (2015). Vivofit. Retrieved from https://buy.garmin.com/en-US/US/prod143405.html.
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Table 2

Relevant Focus Group Questions:

1. Based on your use of the [preferred] device, in the future do you think that this device would motivate you to want to be more active during the day? Why or why not?
2. Which device did you like most and why?
3. Which device would make you want to be more active and why?
4. Would you be interested in wearing this device every day and knowing how active you are each day? Why or why not?
5. Do you think these devices would help you with socialization with your peers? If so, how?

Table 3

Classifications of Visual Impairment Levels

Visual Classification	LogMAR Range	Visual Field Constriction
B1	> 2.60	N/A
B2	1.50-2.60	Diameter of less than 10 degrees
B3	1.00-1.40	Diameter of less than 40 degrees

Source.
International Blind Sports Federation (IBSF). (2014). Classification. Retrieved from http://www.ibsasport.org/classification/.

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CHAPTER 3

Results

Demographic data

The participants were 20 youth (13 males, 7 females, M_{age} = 12.65±2.26) with VI, aged nine to twenty, with multiple levels of VI represented. For the child and adolescent participants, 10 were at the B1 VI level, four were B2, and six were B3 (see Table 4 for demographic information).

Research Question Testing

The aim of this study was to utilize qualitative methods to answer the following questions relating to PA motivation for youth with VI in order to inform future interventions. The research questions addressing these aims are:

1. Do youth with VI find PA monitoring devices motivating?
2. Does preference for PA monitoring device vary by sex or VI level among youth?
3. What specific aspects of PA monitoring devices do youth with VI find motivating?

Results for questions one and two may be found in Table 5, which is based upon the verbal survey. In regard to the first research question, "Do youth with VI find PA monitoring devices motivating," 15 out of the 20 youth participants responded positively, that these devices, based upon their usage of them, would motivate them for PA more than their typical daily levels

of perceived PA motivation. For example, a 13-year-old female participant with a B1 visual level stated, "…it's easier to see your steps and everything, so…you can set more goals than before because you could actually look at what you're doing." Of the five participants (four B1, one B2) who responded negatively, reasoning included difficulty understanding data (not knowing what Fuel points were), not being able to see or access the device data, not having previous activity data to compare to, and the fact that they some believe they are active simply for the enjoyment of it and not because a device is motivating them. For example, a 16-year-old B1 male responded that he "would rather enjoy sports more than just checking times."

To address question two, both males and females preferred the Fuelband and talking pedometer over the Vivofit, with the majority of both sexes preferring the Fuelband (refer to Table 5). In terms of VI level, those classified as B1—the lowest level of vision—greatly preferred the talking pedometer over the other two devices. For those with more sight in levels B2 and B3, the majority of participants in both levels preferred the Fuelband.

To address question three, Figures 1 through 6 and Tables 6 and 7 summarize the focus group findings of the specific aspects of the devices that the participants found motivating, as broken down by the intrapersonal, interpersonal, and organizational SEM levels and sex and VI level. Figures 1 and 2 display general motivational preference and barrier aspects by SEM level that are incorporated into the devices and involved with device use. Figures 3 and 4 show responses of motivational preference and barrier aspects of the devices by SEM level and sex. Figures 5 and 6 display motivational preference and barrier responses as organized by SEM level and VI level. In addition, Table 6 displays relevant focus group quotes regarding device preferences as organized in themes by SEM level to elaborate upon Figures 1, 3, and 5, and

Table 7 shows quotes involving device component barriers to PA motivation as organized by SEM level to complement Figures 2, 4, and 6.

At the intrapersonal level (see Figure 1 and Table 6), motivational aspects of the devices included components of the Social Cognitive Theory and Goal-Setting Theory that both helped to increase PA-related self-efficacy, such as technological persuasion and encouragement and mastery experiences, and used self-regulation techniques, such as self-monitoring, personal goal-setting, and technology-based feedback, such as the "Goal" message on the Fuelband and the activity encouragement strip on the Vivofit. The devices also allowed participants individually to set SMARTER goals that were specific to them, measureable in terms of steps and calories, attainable for each person, realistic, timely, developed enthusiastically by the participants, and attached to technological and verbal rewards from the devices and from their friends, respectively. The devices also encouraged the participants to use positive self-talk and allowed greater independence in regard to goal-setting and self-monitoring. For example, a male, B1 participant aged 11 years old said of the Fuelband "it can connect to any device…and I'd be able to access the data myself," and of the talking pedometer, a 13-year-old B2 male stated, "for someone who doesn't have good vision…they can always rely on the speaking to help them." Additional intrapersonally-motivating components of the devices were those that allowed ease of access to data (such as the good contrast and visibility of the Fuelband and audibility of the talking pedometer), the waterproof component of the Vivofit, the devices' comfort and convenience, and the devices' aesthetic aspects. By sex (see Figure 3), there was not much difference in device component preferences, though intrapersonally, females preferred the aesthetic components of the devices more than the males, who preferred the visibility components more. By VI level (see Figure 5), there did not seem to be much of a difference in

device component preference by interpersonal or organizational level; by intrapersonal level, however, the B1 participants mainly preferred the audible component, while the more sighted B2 and B3 participants preferred visible components more, such as the contrast and larger font on the Fuelband screen.

Intrapersonal barriers of the devices components to PA motivation included difficulty accessing data (such as a lack of audibility of the Vivofit and Fuelband, lack of contrast on the Vivofit and talking pedometer, difficulty finding the buttons on the Vivofit and talking pedometer, and lack of relevant technology, such as a smartphone or laptop), understanding data (such as with Fuel points), simple enjoyment of activity as PA motivation, a lack of waterproofing with the Fuelband and talking pedometer, and the discomfort of the devices (see Figure 2). By sex, there was not too much difference in perceived barriers, as both males and females mentioned the same issues with the devices (see Figure 4). By VI level, there seemed to be very little difference in barrier themes as well, as participants of all VI levels mentioned similar barriers (see Figure 6).

At the interpersonal level, the social support aspects of the Social Cognitive Theory and Goal-Setting theory were frequently brought up, as they allowed for verbal persuasion, peer feedback, and action cues through social interaction, play, encouragement, common goal-setting, and competition (see Figure 1). In regard to socialization, a 15-year-old B1 male participant stated "I think that the whole conversation [part]…would actually not only help socialize, but it would raise your level of activity and thus provide an incentive, a motivation to do this." On the more competitive side, a 12-year-old B3 female said, "Me and Coach, we had a contest to see who would get more, and I beat her." By sex (see Figure 3), there was a slight difference, as the male participants mentioned the competitive aspect of the devices more often, and the females

spoke of the socializing aspect more. By VI level (see Figure 5), there did not appear to be much difference in terms of how frequently device component preference themes at the social level were mentioned.

Interpersonal barriers of the devices included the lack of PA as a common conversation topic, self-consciousness surrounding wearing a PA monitoring device, and the lack of interactive technology such as a phone or computer (see Figure 2). By sex, the females were those who mentioned all of the barriers, while the males did not mention any interpersonal barriers (see Figure 4). By VI level, what little difference there was (such as self-conscious feelings versus not often using PA as a conversation topic) may be due to individual personality differences (see Figure 6).

Finally, at the organizational level, device use for individualized education planning and PE-related PA was mentioned as a way to integrate these devices into school and PE settings as an adapted way to increase PA and independence for this population (see Figure 1). Though the participants often stated that they felt they were fairly active in school, this activity is typically not measured—except for the participant who said that she has been given a pedometer to use in school before. There was not much difference in preference by sex at the organizational level, as participants of both sexes agreed that the devices would be useful in the school setting by incorporating them into individualized education plans and in PE (see Figure 3). Similarly, by VI level, participants of all levels mentioned that PA monitoring devices could help encourage them to be more active in school (see Figure 5). In terms of barriers at the organizational level, none were mentioned at all (see Figures 2, 4, and 6).

Table 4
Participant Demographics (N = 20)

Characteristic	Youth n
Sex	
Male	13
Female	7
VI Level	
B1	10
B2	4
B3	6
Mean Age±SD	12.65±2.26

Note. VI=visual impairment; B1=LogMAR range > 2.60 (least vision); B2=LogMAR range 1.50-2.60; B3=LogMAR range 1.00-1.40.

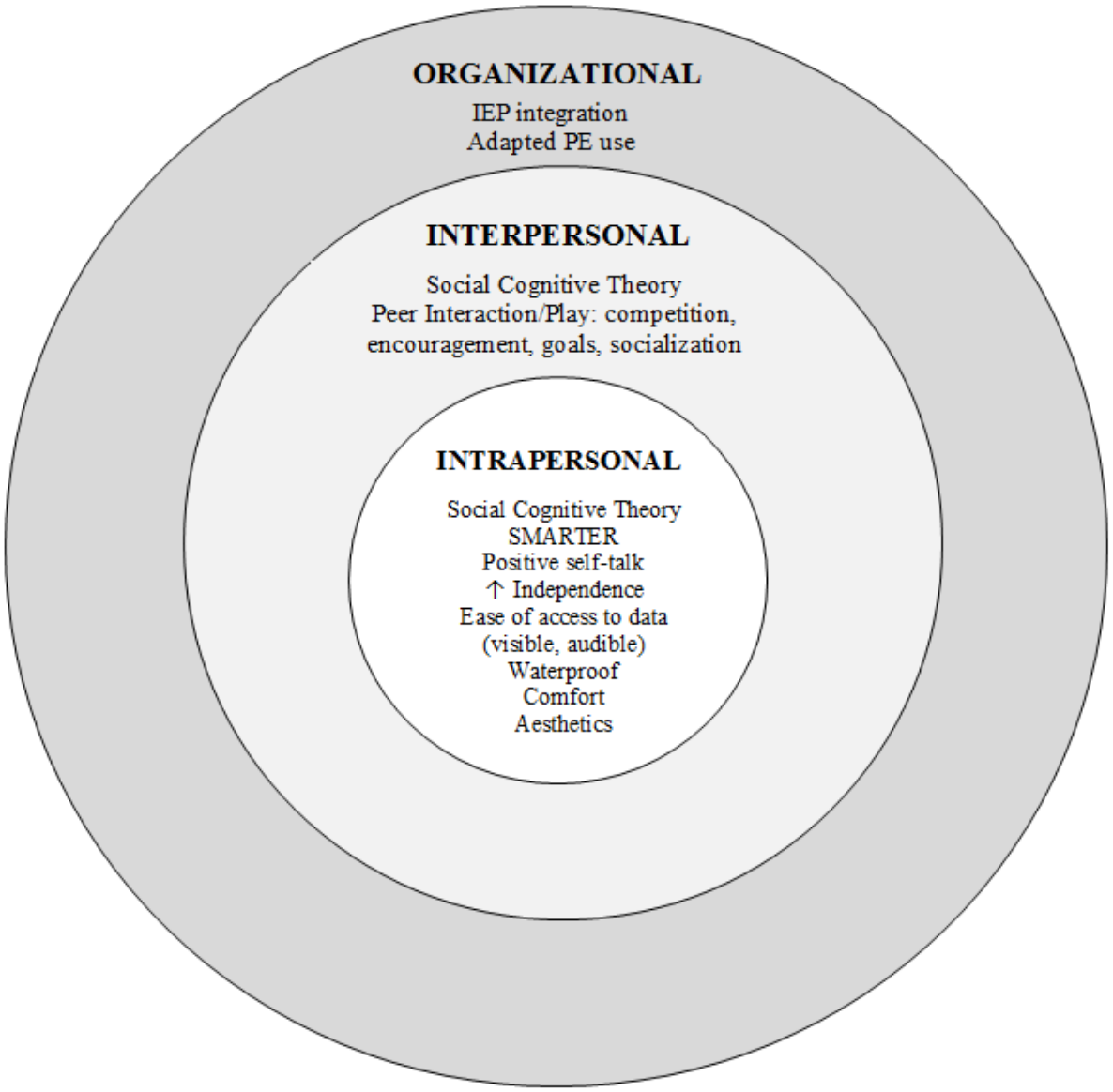
Table 5

Youth Device Preference and Motivational Feedback by Sex and VI Level (N = 20)

	Fuelband	Vivofit	Talking Pedometer	↑ PA Motivation
Characteristic	n	n	n	n
Sex				
Male	7	2	4	10
Female	4	0	3	5
VI Level				
B1	2	1	7	6
B2	3	1	0	3
B3	6	0	0	6
Total	11	2	7	15

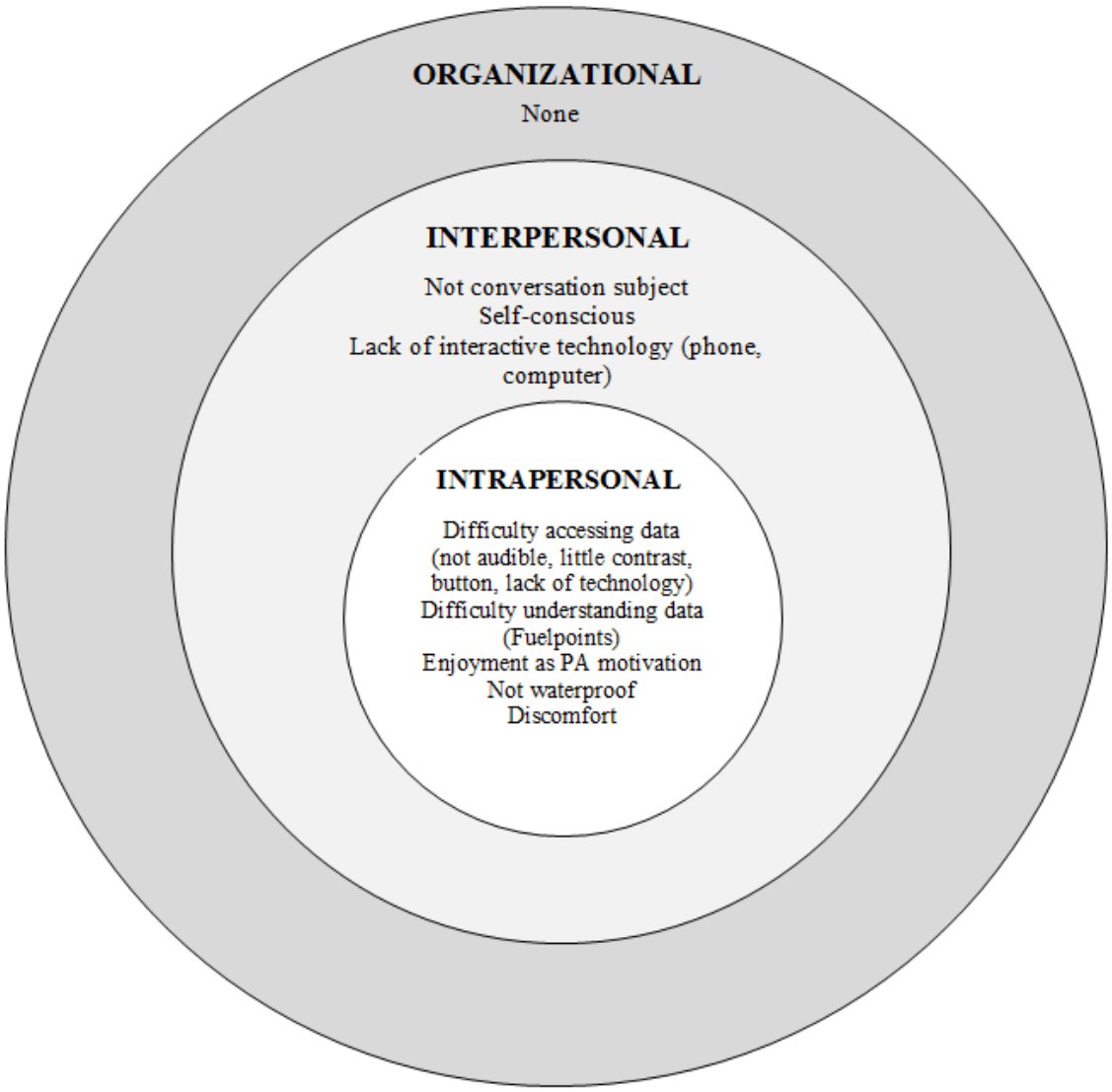
Note. VI=visual impairment; PA=physical activity; B1=LogMAR range > 2.60 (least vision); B2=LogMAR range 1.50-2.60; B3=LogMAR range 1.00-1.40.

Figure 1
Motivational Aspects of the PA Devices by Three SEM Levels: Preferences



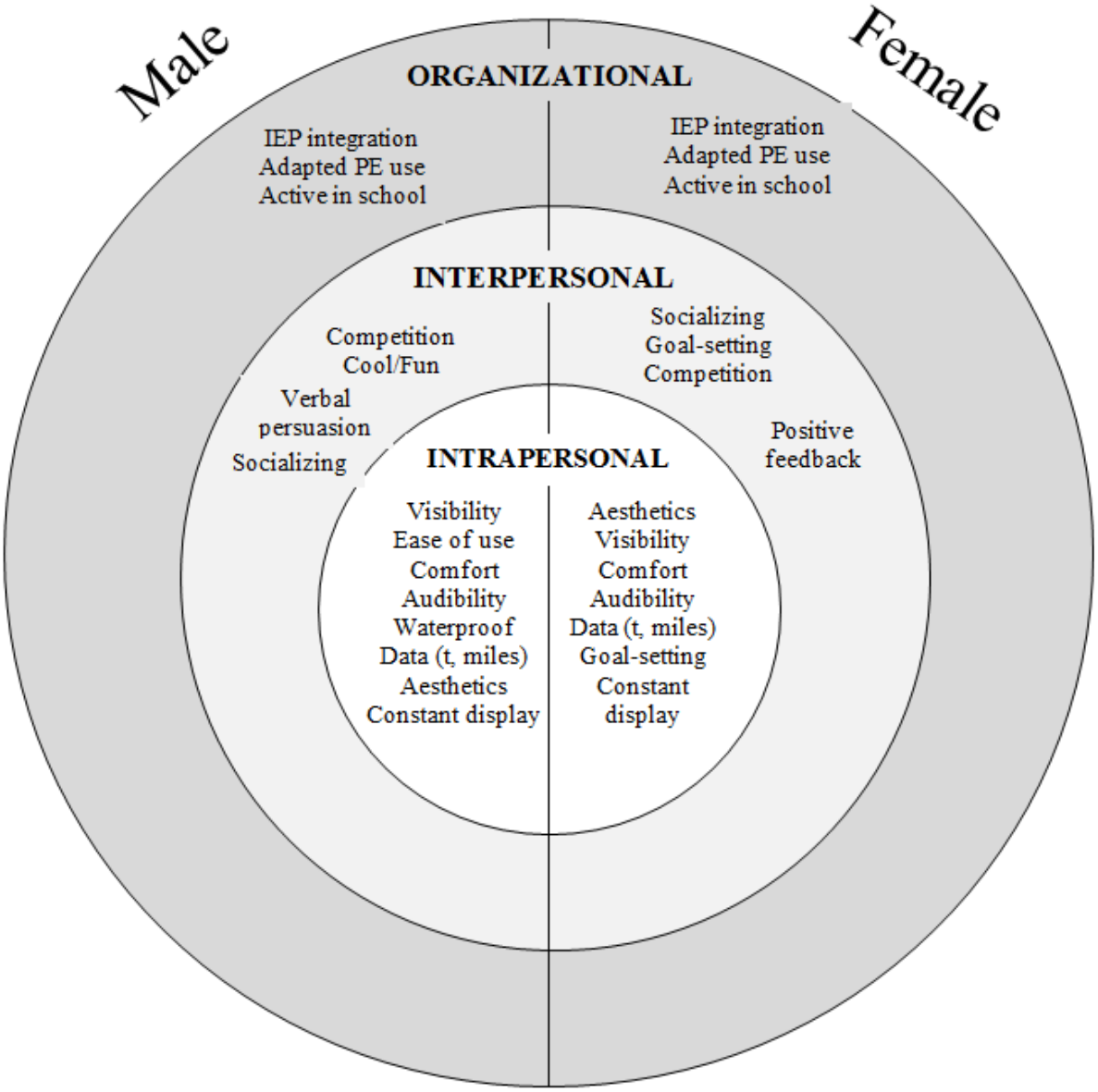
Note. PA=physical activity. SEM=Social Ecological Model. IEP=individualized education plan. PE=physical education. SMARTER=acronym for goal-setting that is specific, measurable, attainable, realistic, timely, developed enthusiastically, and attached to rewards.

Figure 2
Motivational Aspects of the PA Devices by Three SEM Levels: Barriers



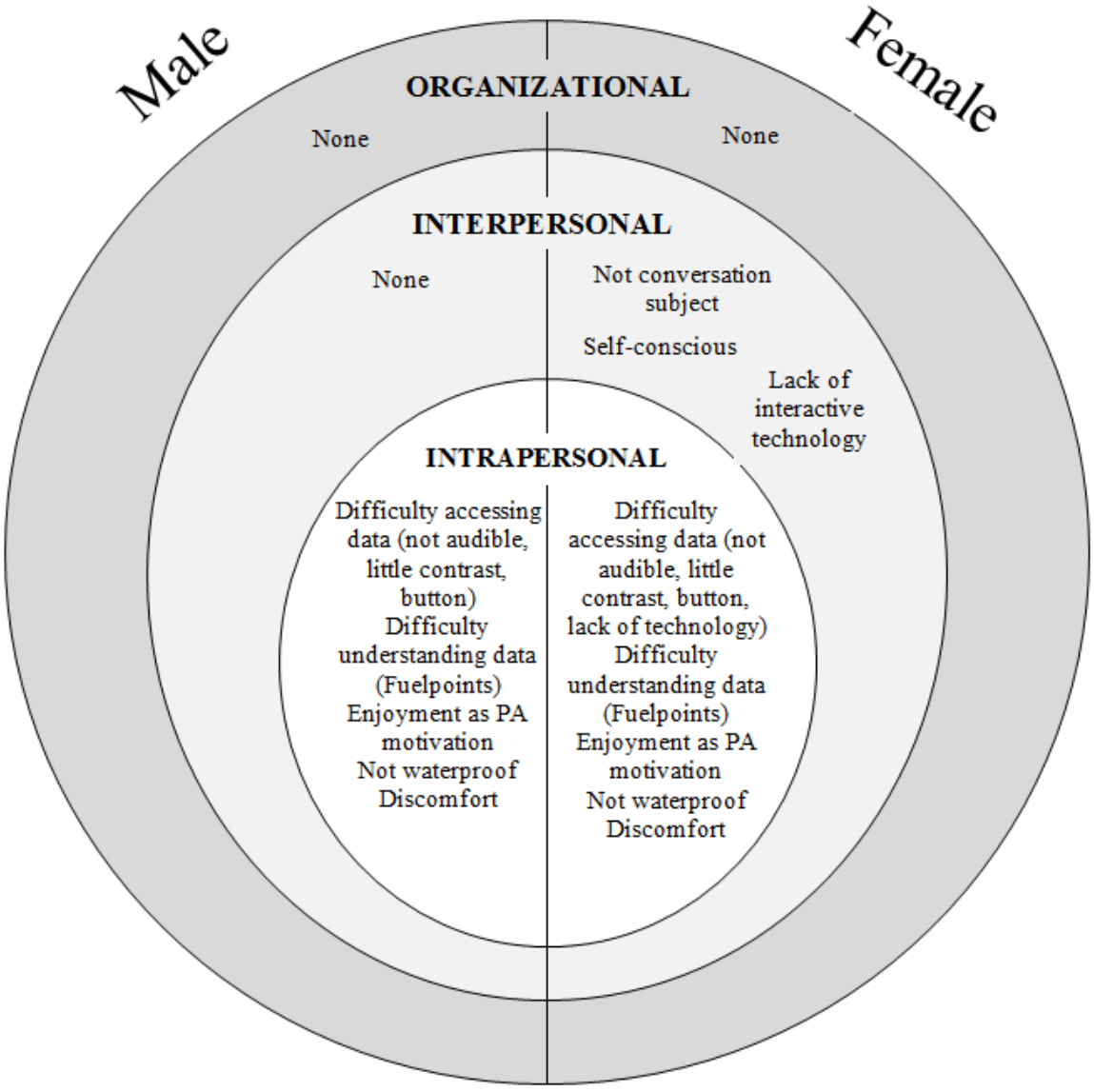
Note. PA=physical activity. SEM=Social Ecological Model.

Figure 3
Motivational Aspects of the PA Devices by Sex and SEM: Preferences



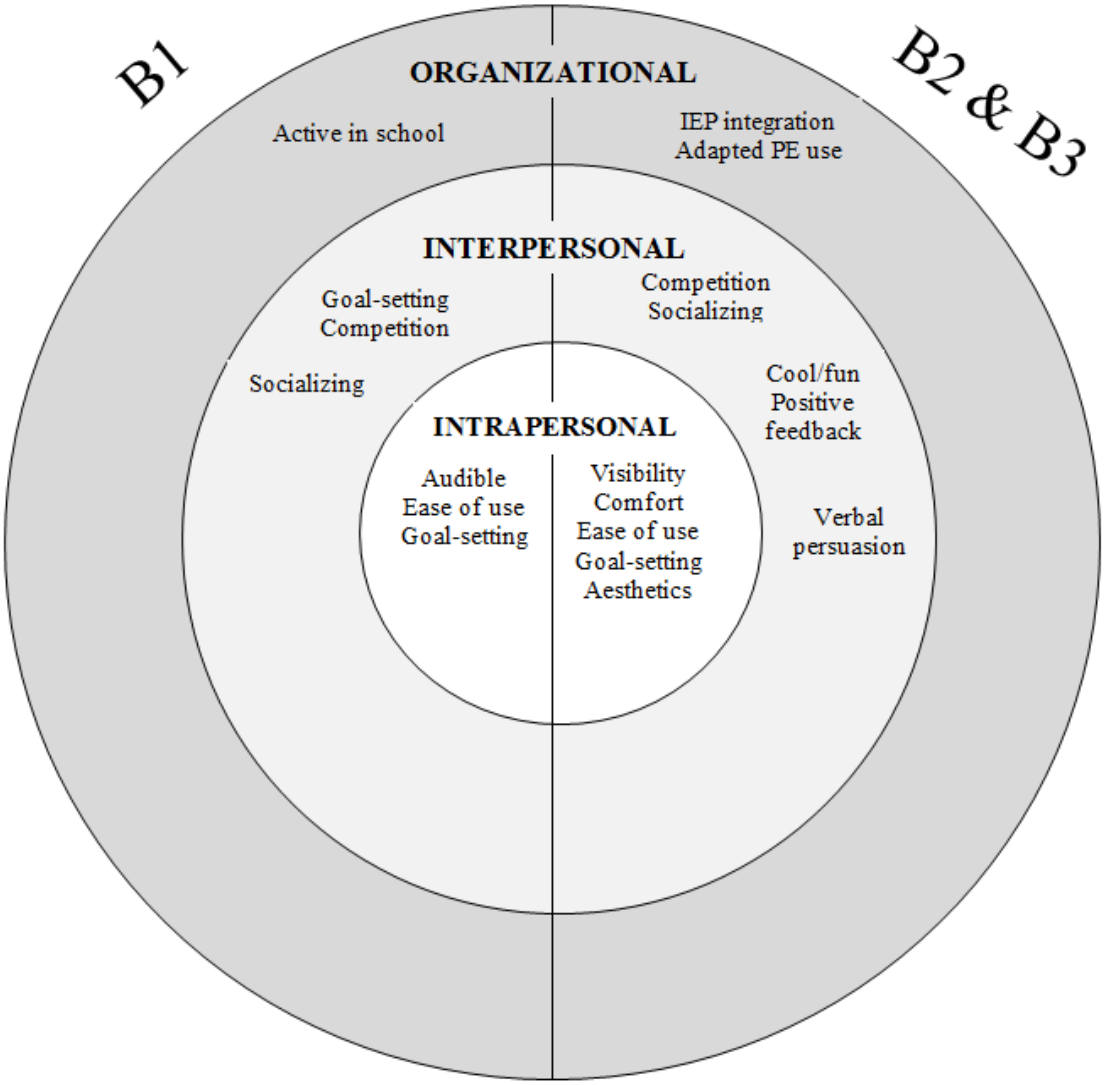
Note. PA=physical activity. SEM=Social Ecological Model. IEP=individualized education plan. PE=physical education. t=time.

Figure 4
Motivational Aspects of the PA Devices by Sex and SEM: Barriers



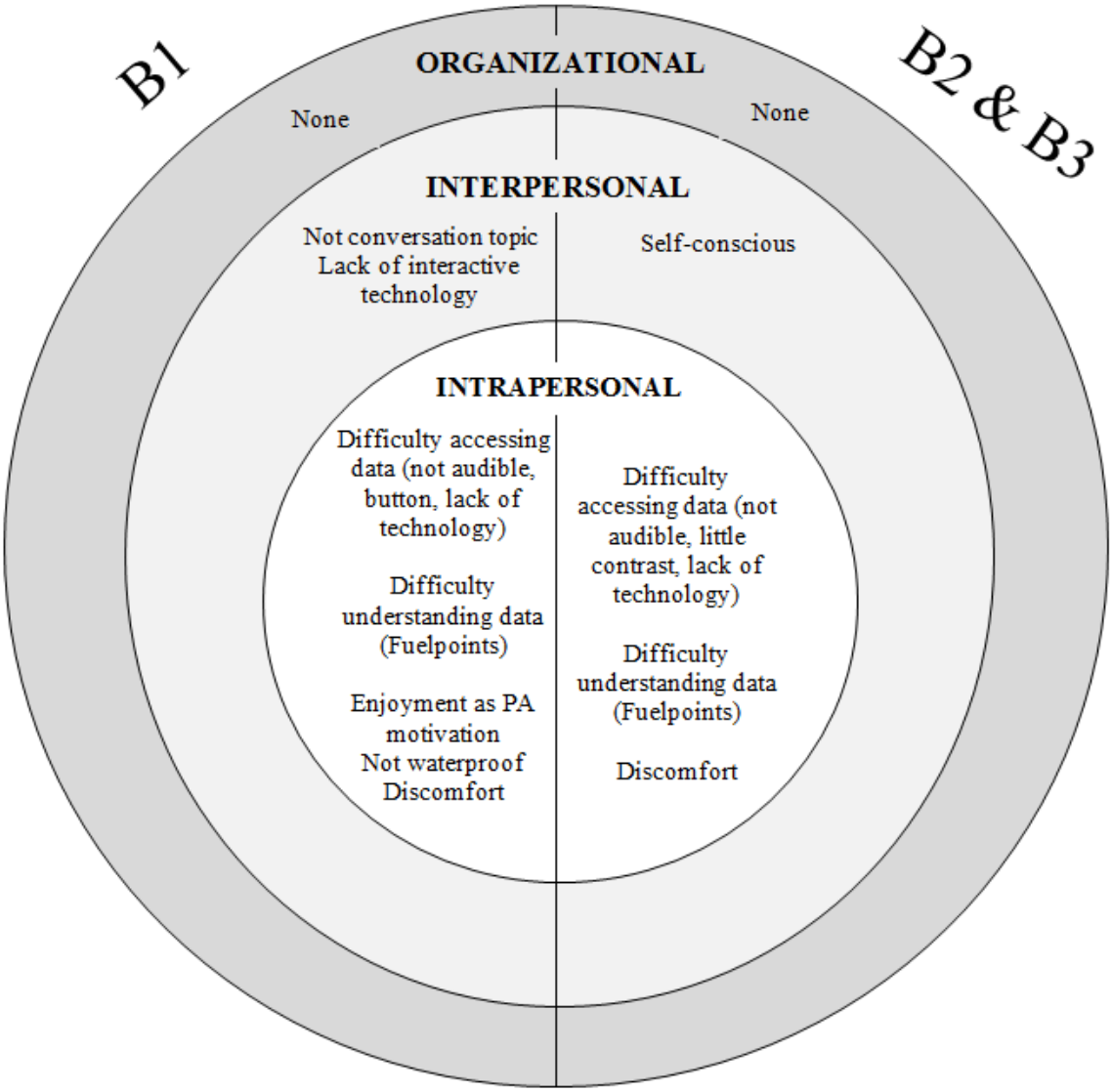
Note. PA=physical activity. SEM=Social Ecological Model.

Figure 5
Motivational Aspects of the PA Devices by VI Level and SEM: Preferences



Note. PA=physical activity. VI=visual impairment. SEM=Social Ecological Model. B1=LogMAR range > 2.60 (least vision); B2=LogMAR range 1.50-2.60; B3=LogMAR range 1.00-1.40. IEP=individualized education plan. PE=physical education.

Figure 6
Motivational Aspects of the PA Devices by VI Level and SEM: Barriers



Note. PA=physical activity. VI=visual impairment. SEM=Social Ecological Model. B1=LogMAR range > 2.60 (least vision); B2=LogMAR range 1.50-2.60; B3=LogMAR range 1.00-1.40.

Table 6
Focus Group Quotes of Motivational Aspects of Devices by SEM Level

SEM Level	Relevant Quote
Intrapersonal	
SCT:	
- Self-efficacy	"you could set yourself a goal for that day, and if you beat it, you could try to beat that the next day, and try to beat that the next day, and you could keep a little system going, and become ever more and more active each day." (male, age 10, B3)
- Self-regulation	"It's easy to see your steps and everything, so…you can set more goals than before because you could actually look at what you're doing." (female, age 13, B1)
SMARTER Goal-Setting	"I like setting goals: I'm going to do so much today, so much tomorrow." (male, age 11, B1)
Positive Self-Talk	"…it's always good feeling that you did more." "I felt like I was trying to check it every five minutes, like 'Oh, can I get over 5,000 Fuel points today? Can I burn this many calories?' And I kept on pressing it throughout the day." (female, age 16, B2)
Increased Independence	"it can connect to any device…and I'd be able to access the data myself" (male, age 11, B1)
Ease of Access to Data	
- Visible	"I like the Fuelband better because it glows up, and I can see it better…it helps me because it's bigger than the other numbers." (male, age 9, B2)
- Audible	"…[understanding the data] would be easier [with] the talking pedometer…instead of having someone having to tell you." (male, age 9, B2)

Waterproof	"I like going in the water…the [Vivofit] water advantage is huge." (female, age 13, B1)
Comfort/Convenience	"I found the Fuelband easier to get on." (male, age 13, B3)
Aesthetics	"I think it's easier to…blend into an outfit…it still could be fashionable and look sporty" (female, age 13, B3)
Interpersonal	
SCT: Social Support	"I think it would increase [peer socialization] more because you could talk to your friends, and if you…both wanted to go running, you could both set each other a goal…then you could try to beat it." (male, age 10, B3)
Peer Interaction/Play	"…it would help…having competitions…or even just setting goals with each other…that could open up other conversations that would be sports related." (female, age 18, B1)
Organizational	
Individualized Education Plan Integration	"You could almost turn it into a teaching thing, how a lot of people are doing…their reverse classrooms, teaching more in schools and making the kids do more work out of school?" (male, age 20, B3)
Adapted PE	"…for phys. ed…how do you know if they actually went home and did whatever you told them to do, push-ups, whatever? So you could have them go do something with Fuelbands and have a classroom set-up on the website so that the teacher could go on and see that he used the Fuelband and how much work he did…" (male, age 20, B3)

Note. SEM=Social Ecological Model. SCT=Social Cognitive Theory. B1=LogMAR range > 2.60 (least vision). B2=LogMAR range 1.50-2.60. B3=LogMAR range 1.00-1.40. SMARTER=acronym for goal-setting that is specific, measurable, attainable, realistic, timely, developed enthusiastically, and attached to rewards. PE= physical activity.

Table 7
Focus Group Quotes of Barrier Aspects of Devices by SEM Level

SEM Level	Relevant Quote
Intrapersonal	
Difficulty accessing data	
- Not audible	"If I could make one change…it would be that if [the bands] could talk…because if a totally blind person is using it and there's no one around at the time" (male, age 11, B2)
- Little contrast	"I don't like the [Vivofit] because the numbers and the letters in the perimeter are really small, and I can't see them" (male, age 9, B3)
- Button	"I never even found the button on the Vivofit" (female, age 13, B1)
- Lack of technology	"I don't have a working computer or a phone, so this would not work good for me" (female, age 14, B1)
Difficulty understanding data	
- Fuel points	"The Fuel points, they're kind of cool, but they're not really that big a deal to me because…what is that? I don't even know what that is." (female, age 13, B1)
Enjoyment as PA motivation	"I would rather enjoy sports more than just checking times" (male, age 16, B1)
Not waterproof	"Most of the stuff I do is in the water, so they really wouldn't be of as much use." (male, age 14, B1)
Discomfort	"I noticed on the Nike Fuelband that it was sort of tricky for me to find the thing to get it on and off my wrist to open it." (male, age 13, B2)
Interpersonal	
Not conversation subject	"You don't really talk about how many steps you take in a day" (female, age 13, B1)
Self-conscious	"I know especially with girls of a teenage age, sometimes, you know, being self-conscious and

	wondering what people are going to think about it, or you know, girls will say, "Oh, I did burn 2,000 calories," and you only burned 500, sometimes I think that could have a negative impact" (female, age 13, B3)
Lack of interactive technology	"My classmates are more obsessed with their phones…and I don't even have a phone or any hope of getting one" (female, age 14, B1)
Organizational	None

Note. SEM=Social Ecological Model. B1=LogMAR range > 2.60 (least vision). B2=LogMAR range 1.50-2.60. B3=LogMAR range 1.00-1.40. PA=physical activity.

CHAPTER 4

Discussion and Conclusions

Discussion of Results

The current study offers insight into PA motivation in a previously underserved population. This study adds to our knowledge of intrapersonal, interpersonal, and organizational level motivating components of PA-monitoring devices and breaks down device preference by VI level and sex. PA motivating components of these devices seemed mainly to fall into the intrapersonal and interpersonal levels of goal-setting. Overall, the biggest differences in motivational aspects of the devices found from the verbal survey and focus group analysis were the sex differences at the intrapersonal and interpersonal levels and the VI level differences at the intrapersonal level.

To address research question one, the majority of participants reported that their preferred device would be sufficiently motivating for them to increase their PA levels. The motivational aspects of these devices may be tailored to individual activity goals, whether they are lifestyle-based or sport or exercise-based. For those B1 and B2 participants who responded negatively, that the devices they wore would not motivate them for PA, having audible or accessible devices with understandable measures of data (unlike Fuel points) that they can compare to previous PA values in order to set goals may be more motivating.

In regard to research question two, for device preference in terms of sex, there was not much difference for device preference based on sex, as both sexes preferred the Fuelband;

however, there was a difference in the reasons for this preference. In general, the most common reason females preferred their devices was for more aesthetic or appearance-based aspects, such as contrast, color, and display, while males more often preferred functional aspects, such as ease-of-use, comfort, and audible, waterproof, and data display components. This finding aligns with Sol Moren's Aesthetic Technology hypothesis, in which females often have an aesthetic approach when they learn, use, or develop technology, in contrast to males, who may value the functional part of technology as more important (Moren, 2012). In an applied aspect, this difference in gender between functional versus aesthetic value is supported by Abbott and Barber who found similar gender differences in functional and aesthetic factors of body image in Australian adolescents (Abbott & Barber, 2010). For 1,526 participants of varying ethnicities aged 12-17, the investigators gathered information using the Embodied Image Scale, pubertal timing, and body mass index and found that the girls reported significantly higher aesthetic values and aesthetic-behavioral investment, while boys reported higher functional values and behavioral-investment. These examples, found by Moren and by Abbott and Barber, seem to be an extension of the concept of 'habitus,' a set of acquired actions, values, expectations, and dispositions of a social group that are "the link between social structures and social action," for example, one's technology preferences which reflect society's predisposed gender expectations (Scott & Marshall, 2009).

To further discuss research question two, with increasing vision, device preference trended from talking pedometer to Fuelband with youth, most likely because the auditory component of the talking pedometer allowed participants with less vision to be more independent—and not have to ask those around them what their wrist-worn devices showed—while the Fuelband had the greatest visual contrast and the largest display and could more easily

be seen by those with greater vision. Webster and Roe's *Children with Visual Impairments: Social Interaction, Language and Learning* likewise stresses the function of sight for those youth whose VI level allows it, stating that "children can be trained to make the most of their residual vision, and although this may be tiring, sight cannot be worn out through use. Enhancing lighting conditions depend on the needs of the child concerned" (Webster & Roe, 2002, p. 170). With little to no vision, however, it is difficult to impossible to make any use of sight, and such individuals must totally rely on their other senses. In an article on auditory assistive devices for the visually impaired, Massof (2003) stresses that, "After vision, hearing has the broadest band for acquiring information. Blind people rely almost entirely on hearing to perceive the environment beyond their reach," and this can lead to auditory compensation and over-performance. As a result, auditory devices can aid those with VI to "visualize information and perform daily activities" (Massof, 2003, p. 271). This trend from a more auditory device to one with strong lighting and visual contrast as visual level improves should be taken into account when creating a PA intervention for youth with VI.

In regard to the final research question of the specific aspects of PA monitoring devices that the youth find motivating there were various aspects that emerged during the focus groups that fall into the intrapersonal, interpersonal, and organizational levels of the SEM framework. There were also some differences in device component preferences and barriers by sex and by VI level. At the intrapersonal level, specific components of the devices, such as the constant displays, ease of use, visibility of the displays, and audible aspects, allowed participants to make use of specific goal-setting elements, such as positive self-talk, self-monitoring, and the SMARTER principle. By sex, there was not much difference in barriers, and females preferred more aesthetic-based elements for self-monitoring, while males preferred more functional

motivational aspects for tracking activity. In terms of VI level, those with greater vision preferred more visible aspects of the devices, while those with lesser vision preferred the audible component of the talking pedometer and were more hindered by less contrast and less accessibility.

At the interpersonal level of the social ecological model, concepts such as socializing, competition, and positive peer feedback and verbal persuasion helped to exemplify the Social Cognitive Theory component of social support and also make use of peer interaction and play as motivation for PA. The little difference that existed in barriers by sex may be due simply to personality differences. Females preferred aspects such as socializing over the competitive function of the devices that was more preferred by the males, which aligns with Sol Moren's Aesthetic Technology hypothesis and with Abbott and Barber's body image findings (Moren, 2012; Abbott & Barber, 2010). It appears that the concept of habitus carries over to the interpersonal differences in device motivation as well. Habitus may help to explain the more competitive value placed on the device usage by the males in this study versus the use of the devices for socializing with peers preferred by the females. In a recent literature review by Croson and Gneezy the authors examine the gender differences in social preferences and competitive preferences and had similar findings as this study (Croson & Gneezy, 2009). Croson and Gneezy found that in general, women are more aware of social cues than men and prefer competitive situations less than men, a result of both nature and nurture of our society. Concurrent with this, in the current study, the females' greater preference for the socializing value of these devices and the male's greater value in the competitive aspect they offer fall along the lines of this habitus which reflects gender norms in our society. To conclude discussion of findings at the interpersonal level, by VI level, preferred social components of the devices did

not differ greatly, with fun and socializing as one of the top reasons for motivation, though competition was stressed more by the more sighted participants.

Finally, at the organizational level, there was not much difference by sex or VI level when the few preferences for device use were mentioned, and there were no organizational level barriers mentioned. It was stressed by a male, B3 participant to incorporate these devices into the individualized education plan and physical education classes of students with VI in order to make use of active time during school and improve motivation for PA in school. This would improve upon the previously described lack of adapted PE opportunities in schools, especially in situations in which PE teachers lack the training or confidence to adapt PA to students with VI (Conroy, 2012; Perkins, Columna, Lieberman, & Bailey, 2013). This would also address Lieberman and Houston-Wilson's call for personalized programs within general PE for students with VI that would address their personal PA goals (Lieberman & Houston-Wilson, 2009).

Limitations of the Study

Limitations include the short device usage time for each participant, financial constraints, the lack of a more concrete measure of motivation and PA, and the rather small number of participants who consented. While the setting for this study was very beneficial as a subject pool for the targeted population, it set a one-week limit on the duration of the study, and each participant was only able to wear his devices for one full day; after one week, the participants returned to their families and were no longer hosted in one location by the camp. In addition, the setting may have affected the daily activity levels of the participants because it was a sports camp and therefore had more incentive for constant daily activity. The setting may also have led to social engagement or contamination around the devices, leading the participants to be more interested in using them than they may have been outside of the camp. Because of the cost of

each physical activity monitoring device, only five of each device were purchased, and only five participants per day could wear them; this one day novelty could also have made the devices more interesting than they would otherwise seem. While much data about each participant's motivational variables was gathered during the focus groups, it would have been beneficial to also include more direct subjective and objective measures of PA motivational changes and PA levels, such as a questionnaire that could be administered PA measurement both before, during, and after the study. Finally, because of time, financial, and consenting constraints, the sample size was limited, and a significant proportion of the participants were male and B1 level.

Future studies should encourage a physically active lifestyle across the lifespan by improving intrinsic motivation for PA. This should be done by drawing upon components of the Social Ecological Model, Social Cognitive Theory for long-term behavior change, the Goal-Setting Theory, and SMARTER program for goal-setting (Bronfenbrenner, 1977; Sallis, Bauman, & Pratt, 1998; Bandura; 1986; Locke & Latham, 2006; Mantell, 2012). A holistic and well-rounded PA intervention program that incorporates components of many theories for behavior change may convey to participants many physical, mental, and social benefits of PA in underserved populations. This may be achieved through the use of PA monitoring devices that can deliver personal feedback and encouragement and allow for social interaction and goal-setting techniques that align with the SEM, SCT, Goal-Setting Theory, and SMARTER techniques for effective behavior change.

Conclusions

The results of this study have led to the following conclusions:

1. The use of these PA monitoring devices did lead the majority of the participants of this study to voice greater motivation in PA participation, as self-reported in a verbal survey.
2. Device preference differed by VI level for the youth with VI, with those of lower vision preferring the talking pedometer and those with greater vision leaning toward the Fuelband; device preference did not greatly differ by sex, but reasons for device preference varied by sex, with males preferring more functional aspects of the devices and females preferring more appearance-based aspects.
3. Various PA-motivational aspects of these devices were mentioned which fall under the intrapersonal, interpersonal, and organizational levels of the SEM framework.

Recommendations for Practice

Based on the results of this study, the following recommendations for future research for overcoming PA motivation barriers and forming PA interventions for this population are outlined below:

1. Easy-to-use PA monitoring devices with display screens, such as the Nike Fuelband, Garmin Vivofit, and Centrios talking pedometer, may be used in PA interventions for individuals with VI to increase daily and sport-or-exercise-related motivation for PA. A greater variety of similar easy-to-use devices with display screens are now on the market and may be used as well; these devices include the Garmin Forerunner [Olathe, KS] watch, the Garmin Vivosmart, the Fitbit Charge [San Francisco, CA], the Polar Electro Loop [Kempele, Finland], and the new Apple Watch [Cupertino, CA].
2. Another way to increase motivation for PA would be to draw upon external sources of motivation. The UNICEF Kid Power Band [UNICEF, New York, NY] now available on the market draws upon a more altruistic form of motivation for PA in that tracked PA

helps fund feeding malnourished children around the world; this may be another mode to help increase motivation for PA in a more external way, for those not motivated as much internally.

3. For those with less vision, a device with an auditory or sensory component should be available, as this makes the device more user-friendly for those individuals and also allows for greater independence. A talking pedometer makes use of the motivating auditory component, and vibrating devices, such as the Jawbone Up band [Jawbone, San Francisco, CA] uses vibration to alert users that they have been sedentary for too long. For those with more vision, a device with great visual contrast may be preferred, such as the Nike Fuelband, Fitbit Charge, or Apple Watch, which have large, illuminated display screens.
4. There are many motivational aspects of these devices that fall into different levels of the social ecological model framework and that should be drawn upon for use in future PA promotion programs for this population. These aspects include: components of the devices that allow for SMARTER goal-setting, self-regulation, increased self-efficacy and independence—especially taking into account VI level—social support, peer interaction, competition, and play, and the integration of the devices into one's individualized education plan and adapted PE settings. Devices may be chosen that have components that work best to each individual, depending upon VI level and personal preference. The use of the technology and theory-based components of these devices may be incorporated into one's individualized education plan and adapted PE setting to promote PA and health and encourage social interaction.

By adolescence, individuals with VI often experience health disparities, stemming from low PA levels and barriers to PA, and these disparities lead to higher rates of chronic illness and a reduced quality of life. These recommendations will be useful to mass-target PA motivation and PA levels in this VI population and increase the health and quality of life of at-risk individuals. In future, results and recommendations of this study may be used by single individuals with VI, those creating PA interventions for this population, organizations such as schools that can incorporate these devices into their individualized education plans and adapted PE programs, and the companies creating these PA monitoring devices in order to create devices that may be used to help increase the PA motivation and overall health of a larger proportion of the general population.

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Appendix A: IRB Approval Letter

NOT HUMAN RESEARCH

Date: January 22, 2015

From: Courtney Whetzel, IRB Analyst

To: Joanna Colgan

Type of Submission:	Initial Study
Title of Study:	Motivational Effects of Wearable Physical Activity Monitors for Children with Visual Impairments
Principal Investigator:	Joanna Colgan
Study ID:	STUDY00001090
Submission ID:	STUDY00001090
Funding:	Not Applicable
Review Level:	

The Office for Research Protections determined that the proposed activity, as described in the above-referenced submission, does not meet the definition of human subject research as defined in 45 CFR 46.102(d) and/or (f). Institutional Review Board (IRB) review and approval is not required.

The IRB requires notification and review if there are any proposed changes to the activities described in the IRB submission that may affect this determination. If changes are being considered and there are questions about whether IRB review is needed, please contact the Office for Research Protections. This correspondence should be maintained with your records.

Appendix B: Recruitment Letter

Dear Parents,

My name is Liz Lenz and I would like to invite your child to participate in this study to determine the motivational aspects of The Nike Fuelband. The project is entitled Motivational Aspects of the Nike Fuelband for Children with Visual Impairments.

Approximately 12-15 children, aged 9-17, will participate in this study. Data collection will take place during the 2014 Camp-abilities held on the campus of The College at Brockport, Brockport, NY. It involves you answering the attached demographic questionnaire and your child answering the interview questions. We will also ask children to be in a focus group with their peers who have worn the Nike Fuelband, Garmin, and s as well. Your child will be asked to wear the Nike Fuelband, Garmin, and talking pedometer for an entire day and then learn how to download and access the data. The Nike Fuelband and Garmin measures energy expenditure during the day in the form of "Fuel Points", steps taken and hours they spend in activity. The talking pedometer measures steps taken during the day and provides an audio output of the steps.

Participating in this exploratory research study is the choice of you and your child. If you choose to have your child participate, we will ask for the child's consent as well. If at any time the child does not want to participate, the study will stop. Not taking part in this research study will in no way affect your child as a member of the camp, nor are there any foreseeable risks or benefits to your child participating.

If you choose to have your child participate in the study, he/she will be given ample encouragement. Participation in this study will in no way impede on your child's participation in camp activities. If your child decides not to partake in the study when asked, he/she will be offered another chance at a later time if desired.

All data collected will remain confidential along with all personal information. Data will be kept on a password protected computer and locked in a filing cabinet and will be destroyed when the research has been completed.

If you want to know more about this project, please contact Dr. Liz Lenz at egrimm@brockport.edu. If you have any concerns or questions about your rights or your child's rights as a research participant, or would like to report any grievances (anonymously if desired), you may contact the Brockport Human Services Institutional Review Board Administrator, Colleen Donaldson at (585) 395-5118 or at irboffic@brockport.edu.

In order to have your child participate in this study, your informed consent is required. Every child who has a signed informed consent form will be asked to participate in the study.

No child will be excluded for any reason. We ask you to read and sign the enclosed consent form and bring it back with you to the registration day.

Thank you for your kind consideration,

Elizabeth Lenz

Appendix C: Informed Consent for Parent

This form describes a research study being conducted with Camp Abilities Brockport students about the motivational effects of the Nike^{+} Fuelband SE Activity Tracker and Fitness Monitors (Fuelband). The purpose of this research is to understand the motivational impact of the Fuelband for individuals with visual impairments. The people conducting the research are faculty members at Roanoke College, The College at Brockport, SUNY, and a graduate student at Penn State University within the department of Kinesiology. If you agree to have your child participate in this study, s/he will be required to wear the Fuelband for a full day, download the data from the day, and answer interview questions. Participants will also be asked to join a focus group of their peers who also wore the Fuelband for the day. The wristband will be worn on the wrist of the hand your child uses most often. At the registration day for camp, you will also be asked to complete a brief questionnaire about your child. Your child will also be asked to answer interview questions and participate in a focus group. The interview and the focus group will be audio taped.

The possible benefit from being in this study could be that information will be learned that would allow teachers, doctors, families, and public health administrators to promote the use of Fuelbands for motivational purposes.

Risks in this study are minimal. Your child may feel embarrassed when wearing the Fuelband and other devices.

Your child's participation in this study is completely voluntary. Being in it or refusing to be in it, will not affect your child's involvement with Camp Abilities, Brockport. S/he is free to change her/his mind or stop being in the study at any time.

I understand that:

1. My child's participation is voluntary and s/he has the right to refuse to answer any questions. S/he will have a chance to discuss any questions s/he has about the study with the researcher after completing the questionnaire.

2. My child's confidentiality is protected. Her/his name will not be written on the interview or focus group question forms. If any publication results from this research, s/he would not be identified by name. Results will be described using pseudonyms so your child’s confidentiality will be intact.

3. There will be few risks, including possible embarrassment from wearing the band.

4. My child's participation involves wearing a Fuelband, a Garmin and a talking pedometer for one day and downloading the results. They will participate in one interview and one focus group related to their feelings about the motivational aspects of the Fuelband, Garmin and talking pedometer.

5. Approximately 12-15 people will take part in this study. The results will be used for the completion of a research project by the primary researcher.

6. Data and consent forms will be kept separately in a locked filing cabinet and in a password-protected document, on a password- protected computer by the investigator and will be destroyed by secure deletion when the research has been completed.

This project has been approved by the SUNY College at Brockport's Institutional Review Board. Approval of this project only signifies that the procedures adequately protect the rights and welfare of the participants. Please note that absolute confidentiality cannot be guaranteed due to the limited protections of Internet access.

You are being asked whether or not you will permit your child to participate in this study. Remember, you may change your mind at any point and withdraw from the study. Your child can refuse to participate even if you have given permission for her/him to participate.

I understand the information provided in this form and understand that completion of the survey signifies my consent for my child to participate in the research study. I am 18 years of age or older. I have read and understand the above statements. All my questions about my child's participation in this study have been answered to my satisfaction.

If you have any questions you may contact:

Primary researcher	
Liz Lenz Ph.D.	
egrimm@brockport.edu	

I am 18 years or older and I agree to let my child take part in this project. I know what he/she will have to do and that he/she can stop at any time.

_____ _____

Parent's Signature Date

_____ _____

Child's Name Child's Birthdate

Appendix D: Informed Consent for Minors

This form describes a research study being conducted with Camp Abilities Brockport students about the how the Nike^{+} Fuelband SE Activity Tracker and Fitness Monitors (Fuelband), the Garmin, and talking pedometers help you to be motivated to be more active. The purpose of this research is to understand how Fuelbands or talking pedometers help you want to be more active. The people conducting the research are faculty members at Roanoke College, The College at Brockport, SUNY, and a graduate student at Penn State University within the department of Kinesiology. If you agree to participate in this study, you will be required to wear the two Fuelbands for a full day, and a talking pedometer. You will then download the data from the Fuelbands for the day and answer interview questions. The Fuelbands give you information about how active you were during the day, your steps that you took that day and how many hours you were active. You will also be asked to join a focus group of your peers who also worn the Fuelbands and talking pedometer for the day. The wristband will be worn on the wrist of the hand you child use most often. The pedometer will be worn on your waist. By the registration day of camp, your parent/guardian will also be asked to complete a brief questionnaire about you. You will also be asked to answer interview questions and participate in a focus group. The interview and the focus group will be audio taped.

The possible benefit from being in this study could be that information will be learned that would allow teachers, doctors, families, and public health administrators to promote the use of Fuelbands and talking pedometers. The use of these tools may help others be more active and healthy.

Risks in this study are minimal. You may feel embarrassed when wearing the Fuelband and other devices.

Your participation in this study is completely voluntary. Being in it or refusing to be in it, will not affect your involvement with Camp Abilities, Brockport. You are free to change your mind or stop being in the study at any time.

I understand that:

1. My participation is voluntary and I have the right to refuse to answer any questions. I will have a chance to discuss any questions I have about the study with the researcher after completing the questionnaire.

2. My confidentiality is protected. My name will not be written on the interview or focus group question forms. If any publication results from this research, I will not be identified by name. Results will be described using pseudonyms so your confidentiality will be intact.

3. There will be few risks, including possible embarrassment from wearing the Fuelband and talking pedometer.

4. My participation involves wearing two Fuelbands for one day and downloading the results. I will also wear a talking pedometer. I will participate in one interview and one focus group related to my feelings about the Fuelbands and talking pedometer.

5. Approximately 9-17 people will take part in this study. The results will be used for the completion of a research project by the primary researcher.

6. Data and consent forms will be kept separately in a locked filing cabinet and in a password-protected document, on a password- protected computer and be destroyed by secure deletion when the research has been completed.

This project has been approved by the SUNY College at Brockport's Institutional Review Board. Approval of this project only means that the procedures protect the rights and welfare of the participants.

You are being asked whether or not you want to participate in this study. Remember, you may change your mind at any point and withdraw from the study. You can refuse to participate even if your parent/guardian has given permission for you to participate.

If you have any questions you may contact:

Primary researcher	
Liz Lenz Ph.D.	
egrimm@brockport.edu	

_____ _____

Child's Signature Date

Appendix E: Demographic Questionnaire

1. What is your child's height? _____ inches
2. What is your child's weight? _____ pounds
3. What is your child's gender?

   ___ Male ___ Female ___ Transgender

   ___ Prefer not to say
4. What is your child's age? _____ years
5. What year is your child in school? _____ grade
6. When was the onset of your child's visual disability?
   ___ Congenital___ Non-congenital (please describe: _____
7. What is your child's level of visual impairment?
   ___ Travel vision (ICD 1-3; finger counting ability at 1-meter)

   ___ Light perception (ICD 4; child sees shadows or light)

   ___ No light perception (ICD 5; child cannot see light)
8. What type of mobility aid does your child use?
   ___ White cane

   ___ Guide dog

   ___ My child does not use a mobility aid___ Other (please describe: _____
9. Is your child's visual impairment progressive? _____Yes _____No
10. Does your child have any other disabilities?

    ___ Yes (please list: _____)
    ___ No
11. Where does your child attend school?

    ____ Residential school____ Public School
    ____ Combination
    ____ Other

Appendix F: Focus Group Questions

These questions were provided to each group's focus group at the end of the day after all of the participants in that group wore the Fuelband, Vivofit, and Talking Pedometer for that day.

1) Have you ever worn a Nike Fuelband, or a Garmin before? If so what did you think about it?
2) Have you ever worn a pedometer/talking pedometer before? If so what did you think about wearing that device?
3) Did you find downloading the information from the Nike Fuelband or Garmin was difficult? Was it easy?
4) Could you do it on your own if you were asked to?
5) Did you use the application TapTapSee? What did you think of that program?
6) Did you understand what the numbers meant such as fuel points, steps taken and hours active?
7) What did these numbers mean to you?
8) Would you be interested in wearing these devices every day and knowing how active you are each day?
9) If so why would you like it? Which one would you like most and why?
10) If not why not?
11) Do you think these devices would make you want to be more active during the day? If so why?
12) Do you think these devices would help you with socialization with your peers? If so how?
13) What are your other thoughts about these devices?
14) If you could change anything about it what would you change?
15) Other last thoughts?

Appendix G: Focus Group Coding Tree

1. Demographics
    a. Gender
        i. M
        ii. F
    b. Visual Impairment Level
        i. B1
        ii. B2
        iii. B3
    c. Age
        i. 9
        ii. 10
        iii. 11
        iv. 12
        v. 13
        vi. 14
        vii. 15
        viii. 16
        ix. 17
        x. 18
        xi. 19
        xii. 20
2. Worn a device before
    a. Nike Fuelband
        i. Yes
        ii. No
    b. Garmin Vivofit
        i. Yes
        ii. No
    c. Talking pedometer
        i. Yes
        ii. No
3. Accessing Data
    a. Difficult
    b. Easy
    c. changes to access data
    d. Independence--could access on own
        i. Yes
        ii. No
    e. Preferred mode
        i. Phone
        ii. Computer
        iii. Band
4. TapTapSee App

   a. + feedback
   b. - feedback
5. Understanding/Interpreting Data
   a. Yes
   b. No
   c. Most important info
6. Interested in Wearing/Using Daily
   a. Yes
   b. No
7. Preferred Device/ + Feedback
   a. Nike Fuelband
      i. Comfort/convenience
      ii. Aesthetics
      iii. Ease of access to data
   b. Garmin Vivofit
      i. Comfort/convenience
      ii. Aesthetics
      iii. Additional data
      iv. Waterproof
      v. Ease of access to data
   c. Talking pedometer
      i. Auditory component
      ii. Comfort
8. Least preferred device/ - Feedback
   a. Nike Fuelband
      i. No auditory component
      ii. Fuel points
      iii. Discomfort
      iv. Lacking data/info
      v. Difficulty of access to data
      vi. Stretchable
   b. Garmin Vivofit
      i. No auditory component
      ii. Difficulty of access to data
      iii. Discomfort
      iv. Stretchable
   c. Talking pedometer
      i. Discomfort/inconvenience
      ii. Inaccurate
      iii. Difficulty of access to data
9. Motivation for Activity
   a. Increase motivation/activity
   b. No motivation
   c. Which one increases motivation/activity the most
      i. Nike Fuelband
      ii. Garmin Vivofit

iii. Talking pedometer

10. Increased Socialization with peers
    a. Yes
    b. No
11. Changes to device
    a. Nike Fuelband
        i. Auditory component
        ii. Aesthetic
        iii. Waterproof
        iv. Clasp
        v. Anklet
        vi. Music
        vii. Easier to read
        viii. Button
        ix. Slow scrolling time
        x. Lighter
        xi. History in band
        xii. Brailled
        xiii. Price
        xiv. additional data like Garmin Vivofit
    b. Garmin Vivofit
        i. Auditory component
        ii. Aesthetic
        iii. Clasp
        iv. Anklet
        v. Music
        vi. Easier to read
        vii. History in band
        viii. Brailled
        ix. Brighter
    c. Talking pedometer
        i. Aesthetic
        ii. Louder
        iii. Brailled buttons
12. Interesting Quote
13. Most important data/info
    a. Steps
    b. Calories
    c. Miles
    d. Heart rate
    e. Stopwatch
    f. Sleeping patterns
    g. Fuel points
    h. Goal