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Factor Structure of the Barriers to Physical Activity Scale for Youth with Visual Impairments

Jeffrey J. Martin
Wayne State University, aa3975@wayne.edu

Erin E. Snapp
Wayne State University, erin.snapp@wayne.edu

E. Whitney G. Moore
Wayne State University, whitneymoore@wayne.edu

Lauren J. Lieberman
State University of New York College at Brockport

Ellen Armstrong
Griffith University

See next page for additional authors

Authors
Jeffrey J. Martin, Erin E. Snapp, E. Whitney G. Moore, Lauren J. Lieberman, Ellen Armstrong, and Staci Mannella

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Abstract

Youth with visual impairments (VI) often experience unique barriers to physical activity (PA) compared to their sighted peers (Armstrong et al., 2018). A psychometrically sound scale for assessing barriers to PA for youth with VI is needed to faciliate research. The purpose of this paper was to confirm the ability of the previously identified three-factor structure of the Physical Activity Barriers Questionnaire for youth with Visual Impairments (PABQ-VI) to produce scores considered to be valid and reliable (Armstrong et al., 2020; Armstrong et al., 2018) that perform equally well across age, VI severity, and gender. Our results supported the three-factor structure and that the PABQ-VI produces scores considered valid and reliable. Mean, variance, and correlation differences were found in personal, social, and environmental barriers for age and VI severity, but not gender. Researchers can use the PABQ-VI to test and evaluate ways to reduce barriers for this population.

APAQ Word Limit: 150

Keywords: *PABQ-VI, exercise, blind, sport, social cognitive theory*

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Introduction

The negative influence of both physical inactivity and sedentary behavior on long term health and functioning are well documented (Gordon-Larsen et al., 2004). These influences include an increased risk of early mortality due to preventable diseases such as diabetes, cancer, cardiovascular and metabolic disorders (Centers for Disease Control and Prevention, 2017). It is also well documented that youth do not engage in enough physical activity (PA), and conversely, spend too much time being sedentary. Youth with visual impairments (VI), are even less likely to maintain healthy levels of PA and have lower levels of physical fitness and a higher prevalence of obesity compared to sighted peers (Augestad & Jiang, 2015; Houwen et al., 2009).

The gap in PA participation between youth with VI and their sighted peers may be attributed to, in part, the many barriers to PA encountered by youth with VI. One such barrier is reduced opportunities to engage in regular PA (Columna et al., 2019; Stuart et al., 2006). Reduced opportunities to experience and enjoy PA at a young age can lead to patterns of PA avoidance that start with delayed gross motor development, and are exacerbated by low levels of fitness, low perceived PA competence, and fewer opportunities for social interactions (Brian er al., 2018; Robinson, 2011). In contrast, there is compelling evidence that people with visual impairments can participate and excel in PA when the appropriate environmental adaptations and social supports are available (Haegele et al., 2017; Scally & Lord, 2019). Early identification of PA barriers experienced by children with VI is therefore critical.

Youth with VI experience PA barriers that are different to those experienced by the general population, people with other disabilities, and even adults with VI (Armstrong et al., 2018; Greguol et al., 2015; Stuart et al., 2006). The PA barriers experienced by children with VI are complex and vary by factors such as the severity of VI, level of social support, environmental factors as well as their parents' and educators' beliefs and perceptions of PA (Scally & Lord, 2019; Shields & Synnot, 2016; Stuart et al., 2006; Wrzesińska et al., 2017). PA barriers questionnaires developed for adults with VI or other disabilities are not specific enough to capture the barriers relevant to youth with VI (Armstrong et al., 2018; Lee et al., 2014).

In two recent studies, the Physical Activity Barriers Questionnaire for children with Visual Impairments (PABQ-VI) was developed (Armstrong et al., 2020; Armstrong et al., 2018). The PABQ-VI was developed based on an extensive literature review, guided by social cognitive theory (SCT), and informed by children with VI's. In the current study we have expanded the scale to include older children and some young adults resulting in renaming it as the Physical Activity Barriers Questionnaire for youth with Visual Impairments (PABQ-VI)

The first study[1] using the PABQ-VI (Armstrong et al., 2020) focused on developing the scale. The items were developed using social cognitive theory and a review of the literature on VI and PA barriers. Items were then reviewed by an expert panel to determine their fitness and appropriateness for inclusion. Additionally, a semi-structured interview was conducted with a child with VI to demonstrate understanding and positive feedback regarding the structure and delivery. Based on social cognitive theory, the resulting 42 items were divided into the personal, social, and environmental barriers (see Table one). The participants consisted of twenty-one children with VI from Ireland who attended a sports camp for children with VI. All participants had a VI and were categorized as either low vision or complete blindness. In addition to measuring barriers to PA with the PABQ-VI, PA levels and barrier self-efficacy were also assessed. The resultant omega coefficients and the Guttman split-half coefficient, suggested that the personal, social, and environmental subscale scores showed evidence of strong reliability. The personal, social, and environmental subscales had moderately strong and negative relationships with PA levels, supportive of concurrent validity evidence. There were no significant correlations found between any of the subscales and the self-efficacy scale. However, children with low vision reported fewer PA barriers compared to children who were blind.

In a second study (Armstrong et al., 2018) forty-one children from the USA, who attended a residential sports camp, completed the PABQ-VI. The psychometric properties of the PABQ-VI were studied using Pearson product-moment coefficients, as well as the Cronbach's alpha and split-half reliability tests. Convergent validity was determined by analyzing correlations between the PABQ-VI, physical activity (PA) levels and the participant's self-efficacy for their ability to overcome barriers. Both PA participation and barrier PA self-efficacy scores were correlated with the PABQ-VI. Participants who were the most physically active perceived fewer barriers and had much stronger efficacy when compared to the participants who were less physically active. In summary, the PABQ-VI has demonstrated preliminary evidence of convergent validity and internal validity.

A major limitation of both prior studies was the small sample sizes were inadequate to perform a factor analysis or to determine the best performing questions to reduce scale length and therefore subject burden. The Standards for Educational and Psychological Testing determined by the American Educational Research Association (AERA et al., 2014) suggest evidence of a test's ability to produce scores considered valid and reliable is critical. Compelling validity evidence is found if there is support for the relationships among scale items, if items load on hypothesized latent constructs, and if theory is supported (AERA et al., 2014). Confirmatory factor analysis (CFA) is a strong analytical approach to evaluate the latent structure of a scale (Brown, 2015). CFA is used to establish construct validity by confirming whether observed variables (e.g. items) are related to the underlying factor structure and the specific factor they are designed to represent (Brown, 2015).

In order to confirm that the PABQ-VI produces scores considered reliable and valid, a necessary next-step in the development of the PABQ-VI was to collect data using a much larger sample size to satisfy criteria for a CFA. The purpose of this paper, therefore, was to use CFA to confirm the previous identified three-factor structure of the PABQ-VI while simultaneously eliminating poorly performing items to deliver a more psychometrically strong and user-friendly scale. Scales with many items can be a detriment to research participant recruitment (Humphries et al., 2012), particularly when researchers assess multiple constructs or engage in longitudinal work (Marsh et al., 2010). Longer scales also result in more missing data (Stanton et al., 2002). A complementary and secondary aim was to determine if, using a large and diverse sample of youth with VI, PABQ-VI questions performed well across VI severity, age, and gender. The results from this purpose can provide evidence supporting if the PABQ-VI performs equally well for both children and youth with mild VI to those completely blind, for youth ages 8 to 21, and finally if it performs equally well for males and females. Additionally, teachers, coaches, and health professionals can have confidence using the PABQ-VI to identify and address PA barriers that are specific to the youth with VI that they work with.

Methods

Participants

The Institutional Review Board at the lead researchers' university approved this research study. Parents of the participants were provided information about the study and could choose to remove their children from participation. Additionally, participants provided verbal assent prior to completing the questionnaire.

Participants included 264 youth ages 8 to 21 (*M* = 13.31, *SD* = 2.54). There were 129 male, 132 female, and 3 non-disclosed participants. Severity of visual impairment was as follows: low vision (*N* = 150), near blind (*N* = 57, completely blind (*N* = 51). Participants were recruited from Camp Abilities camps, which are sport camps specifically for children with VI's. The camps are hosted throughout the world, but our data were collected within the United States, specifically from Maryland, Utah, New York, Pennsylvania, and Texas.

Questionnaire

In addition to demographic questions (e.g., age, gender), the instrument used was the Physical Activity Barriers Questionnaire for Children with Visual Impairments (PABQ-VI) (Armstrong et al., 2018; 2020). The 42-item questionnaire is composed of three theoretically grounded subscales assessing personal barriers, social barriers, and environmental barriers. The items were rated on a 5-point Likert scale (1 = *strongly agree* to 5 = *strongly disagree*). The personal barriers construct consists of 12 items that focus on the individuals' thoughts and beliefs regarding their ability to engage in PA. For example, "I believe I can do PA even though I have a visual impairment." The social barriers construct consists of 18 items that focus on the influence others, such as parents, teachers, and peers, have on the individuals' ability to engage in PA. For example, "I know other children who will do PA with me." The environmental barriers construct consists of 12 items that focus on the individual's access to engage in PA through the community, school, and general living environment. For example, "I know about opportunities to do PA in my community." Higher scores represent greater perceived barriers.

Procedure

Coaches at each camp were trained to administer the questionnaire prior to the arrival of the children. Each coach read the 42 questions to the child and asked for their answers. In a practice trial with two boys with VI's the questionnaire took between 8 and15 minutes to complete.

Plan of Analysis

Prior to any analyses the data were screened for missing data, quality and normality, including skew and kurtosis $< +3$ or $> - 3$ (Tabachnick & Fidell, 2007). Given prior research with these items and the purpose of the study, the first step was examining the items of the survey for potential differential functioning by important demographics. This step determined if the quality of the data collected by an item varied according to three variables: age, gender, and VI severity. As the items were collected from individuals from the age of 8 to 21, it was important to account for age-associated differences in reading level, so we examined age-group differences. We examined age because age is correlated with reading ability (Oakhill & Cain, 2012). Age was dichotomized as 13 and younger or 14 and older. This split provided relatively even group sizes, important for our analyses, and covered somewhat similar age range length (6 years for 8 to 13 and 8 years for 14-21). Gender was coded male or female and examined because of well-known gender reading differences. Data were collapsed to make two VI categories: mild and moderate/severe.

To examine the quality of the items and reduce the number of items per construct a configural model across gender with all the PABQ-VI items as indicators of their respective latent constructs was conducted. To handle missing data (1% total, no individual scale item had more than 3% missing), full-information maximum likelihood (FIML) was used in *lavaan* (Rosseel, 2012). Indicators with factor loadings in males and females below .50 (i.e., 25% of indicator variance due to the construct) were removed one at time and the model fit re-assessed (Brown, 2015; Kline, 2016). Then the measurement quality of the items across the participants' age was assessed and items with factor loadings below .70 (i.e., 49% of indicator variance due to the latent construct) were tested one at time and considered for removal (Brown, 2015; Kline, 2016). The final set of items was tested for measurement quality across VI severity by configural model fit. Model fit for the configural models examined was based upon the CFI and TLI being .90 or greater and the RMSEA and SRMR being .08 or less (Brown, 2015; Kline, 2016; Little, 2013). Given, the smaller sample size and small model being tested, RMSEA was expected to perform poorly relative to the other fit indices (Brown, 2015; Kline, 2016; Little, 2013).

Next, once the final set of indicators (i.e., items) were determined, measurement invariance was conducted across each of the grouping variables separately. Configural measurement invariance assesses the overall fit of the model and that the indicators are measuring the latent construct they were designed to measure and do not have dual loadings on other latent constructs. Thus, the general pattern for relationships between indicators and constructs is the same for both groups when the configural model as acceptable model fit (criteria presented above). This is followed by weak (i.e., metric) measurement invariance to provide evidence of the indicator factor loadings (i.e., proportion of the indicator's variance due to the latent construct) are equivalent across groups and strong (i.e., scalar) measurement invariance to provide evidence of the indicator intercepts being equivalent across groups. To confirm that these measurement parameters being equated across groups does not result in misfit, the change in two model fit indices were examined. Measurement invariance tests were passed if the CFI did not change by more than .01 and the current model RMSEA fit within the 90% CI for the prior model's RMSEA (Brown, 2015; Kline, 2016; Little, 2013). A change in chi-square was not used because it is overly sensitive (i.e., too powerful) for use during the measurement model steps (Brown, 2015; Kline, 2016; Little, 2013). Attaining measurement invariance provides support for measurement quality equivalence across groups and is critical if researchers seek to use diverse samples that vary across gender, age, and VI severity. In other words, by passing these measurement invariance steps, evidence is build that the ability of the indicators to measure the latent constructs of interest is not different due to a demographic characteristic (i.e., gender, age, and VI severity) of the groups examined. Thus, any differences found in the following examinations of the latent parameters is due to a true difference and not due to differences in the measurement quality between the groups.

Finally, the latent parameters (i.e., means, variances, and correlations) were assessed for moderation by grouping variable. First, an omnibus test of homogeneity for the parameter was conducted, constraining the parameter values across group to equality. If this constraint produced significant mis-fit based upon a significant change in the $\chi 2$ value, then follow-up pairwise comparisons of individual parameters across group were conducted. These follow-up analyses also used the nested model change in $\chi 2$ test. An alpha level of .01 was used for all tests at the latent (i.e., structural) level due to the sample size. As effects-coding was used to identify the latent constructs, phantom constructs were added to the model to enable direct estimation of the latent correlations rather than depending on post-estimation transformation of the correlations as recommended by Little (2013). Using the phantom constructs meant the latent correlations were being directly tested for equality and not latent covariances, because including phantom constructs separates the variances out from the estimation of the association between the latent constructs (Little, 2013).

Results

Item Reduction

See Table 1 for the factor loadings of all PABQ-VI items from the initial configural model (CFI = .668, NNFI = .649, RMSEA = .102, 90% CI [.098, .107], SRMR = .086). The following 12 items were removed as a result of this process: 3, 9, 11, 12, 14, 19, 28, 29, 31, 34, 40, and 41. Items were removed because they had very low factor loadings (e.g., .2 to .4) for both genders in most cases, or in a few cases for one gender. Importantly, we also sought to maintain theoretical and conceptual (i.e., considering item content) coverage of the constructs through this process. This resulted in 9 items loading onto the personal barriers latent construct, 12 items loading onto the social barriers construct, and 8 items loading onto the environmental barriers construct. The resultant model fit was poor (CFI = .778, NNFI = .77, RMSEA = .108, 90% CI [.101, .114], SRMR = .075). Therefore, three parcels comprised of the construct items were then developed using the item-to-construct balanced technique, so each construct was locally just-identified (Little, 2013). Additionally, this technique insures that parcels are similar in terms of their level of difficulty and ability to discriminate (Little et al., 2002). The parceled model had a close fit (CFI = .987, NNFI = .98, RMSEA = .064, 90% CI [.006, .101], SRMR = .035).

Next, a configural model was run using age as the grouping variable to continue examining item measurement quality. Similar to above, the remaining items were screened for factor loadings less than .70 across both groups and then removed from the model one-by-one if below the cutoff criterion. Theoretical and conceptual considerations were also used as guides. There were six additional items removed through this process (See Table 1): 6, 8, 17, 18, 21, and 25. As a result, the final measure was pruned to six items for the personal barriers construct, nine items for the social construct, and eight items representing the environmental construct. The configural model, when run with these items, had a better, but still poor model fit (CFI = .823, NNFI = .803, RMSEA = .116, 90% CI [.107, .124], SRMR = .07). However, with the three parcels for each construct using the item-to-construct balance technique, the configural model with parcels had good model fit (CFI = .961, TLI = .942, RMSEA = .111, 90% CI [.078, .132], SRMR = .037).

Finally, these items were carried forward for examination across VI severity. Similar to the age item-level configural model, the item-level configural model across VI severity had a poor fit (CFI = .840, TLI = .822, RMSEA = .110, 90% CI [.101, .119], SRMR = .066). However, the composite reliabilities for all three constructs based upon the indicator factor loadings provided evidence for strong reliability (see Table 2). Items with potential differences in the magnitude of the factor loadings were anticipated based upon the effect of having different VI severities. Given, the observed differences and strong reliabilities, parcels were calculated, and the configural model produced a good fit (CFI = .970, TLI = .95, RMSEA = .097, 90% CI [.067, .127], SRMR = .047).

Age

After parceling the reduced PABQ-VI items based upon the factor loadings, the configural model had good model fit (See Table 3) in the two-group model across age ($n_{8\text{-}12yoa}$ = 88; n_{13+yoa} = 153). PABQ-VI then passed weak measurement invariance (ΔCFI = .000; RMSEA weak within RMSEA configural 90% CI) and strong measurement invariance (ΔCFI = .001; RMSEA strong within RMSEA weak 90% CI). Passing these two measurement invariance tests provided support for the measurement quality of the PABQ-VI indicators across age. Next, the homogeneity of latent means, variances, and correlations was tested across age groups. The homogeneity of variances test was passed ($\Delta\ \chi^2_3$= 4.18, p = .24). The homogeneity of means did not pass ($\Delta\ \chi^2_3$ = 11.66, p < .009); however, none of the individual means were significantly different when tested pairwise. Finally, the homogeneity of latent correlations test was significant ($\Delta\chi^2_3$ = 12.56, p = .006). Specifically, two correlations were significantly different. The correlation between personal and social barriers was significantly ($\Delta\chi^2$ = 8.39, p = .004) lower for younger participants (r = .85) compared to older participants (r = .97). The correlation between personal and environmental barriers was also significantly ($\Delta\chi^2 = 7.39$, $p = .007$) lower for younger participants ($r = .73$) compared to older participants ($r = .88$). See Figure 1a.

Visual Impairment Severity

After parceling the reduced PABQ-VI items based upon the factor loadings, the configural model had good model fit in the two-group model across VI severity ($n_{mild} = 140$; $n_{moderate/severe} = 99$). PABQ-VI then passed both weak measurement invariance (ΔCFI = -.001; RMSEA weak within RMSEA configural 90% CI) and strong measurement invariance (ΔCFI = .009; RMSEA strong within RMSEA weak 90% CI). Passing these two measurement invariance tests provided support for the measurement quality of the PABQ-VI indicators across VI severity. Next, the homogeneity of latent means, variances, and correlations was tested across VI groups. None of these homogeneity tests were passed (Table 3). The mean of environmental barriers was significantly ($\Delta\chi^2 = 17.91$, $p < .001$) lower for those with mild severity ($M = 2.10$) than those with moderate/severe impairment ($M = 2.44$). The personal ($\Delta\chi^2 = 13.89$, $p < .001$), social ($\Delta\chi^2 = 19.05$, $p < .001$), and environmental ($\Delta\chi^2 = 6.76$, $p = .009$) standard deviations for mild VI was greater ($SD_{personal} = 1.10$; $SD_{social} = 1.09$; $SD_{environmental} = 1.05$) than for those with moderate/severe impairment ($SD_{personal} = 0.77$; $SD_{social} = 0.63$; $SD_{environmental} = 0.80$). Finally, the mild VI participants had a significantly ($\Delta\chi^2 = 20.09$, $p < .001$) lower correlation ($r = .66$) between personal and social barriers compared to those with moderate/severe impairment (r = .93). See Figure 1b.

Gender

After parceling the reduced PABQ-VI items based upon the factor loadings, the configural model had good model fit (See Table 3) in the two-group model across gender ($n_{male} = 118$; $n_{female} = 124$). PABQ-VI then passed both weak measurement invariance (ΔCFI = -.001;

RMSEA weak within RMSEA configural 90% CI) and strong measurement invariance (ΔCFI = .000; RMSEA strong within RMSEA weak 90% CI). Passing these two measurement invariance tests provided support for the measurement quality of the PABQ-VI indicators for both genders. Next, the homogeneity of latent means, variances, and correlations was tested across visual impairment groups. All of these homogeneity tests were passed (Table 3). Thus, gender did not moderate the values for any of the means, variances, or correlations (Figure 1c).

Discussion

The primary purpose of the current study was to further evaluate the PABQ-VI, a theory based PA barriers scale that was specifically developed to target the barriers to PA facing youth with VI (Armstrong et al., 2018; 2020). This purpose was successful as evidenced by the overall adequate model fit for the final 24-item, three factor PABQ-VI. More specifically we used a rigorous analytical technique, confirmatory factor analysis, to see if the items hypothesized to represent each of the three latent factors (i.e., personal, social, and environmental barriers) loaded on the specific factor they were designed to represent with adequate loadings.

Individual factor loadings (see Table 2) were mostly high and ranged from .46 to .92 (with one exception) and met criteria (.40 or greater) designating them as low to high factor loadings (Hair et al., 1998). Associated squared multiple correlations (SMC) typically explained 50% or more of the variance in the three factors. The variance accounted for and the factor correlations support the multidimensionality of the PABQ-VI, and suggests that each subscale measures a unique type of barrier to PA.

Each factor is composed of items that are logically and theoretically related and demonstrate evidence of acceptable internal consistency (i.e., > .70; Tabachnick & Fidell, 2007). The personal barriers subscale has questions that tap into common individual level psychological concepts such as PA confidence, value, and enjoyment. The social barriers subscale includes important social agents that influence PA, particularly for youth, such as parents, teachers, and peers. Finally, the environmental barriers subscale includes common structural barriers such as limited sporting opportunities in the community.

Another important goal was to identify the strongest items representing each latent construct in order to eliminate the weakest items and finalize a scale that minimized subject burden. We achieved both purposes as the final PABQ-VI questions and sub-scales all produced scores that are considered valid and reliable, and that were consistent with the three factor structure developed by Armstrong et al. (2018; 2020). We reduced subject burden by reducing the original scale from 42 items to 24 items. This represents close to a 50% reduction in scale length and completion time, and most importantly we did not sacrifice content coverage (Smith et al., 2000). The items eliminated frequently had redundant item content with questions retained and/or were indefensible from a measurement perspective (e.g., low factor loading of .06).

Another goal was to determine if the PABQ-VI was suitable for youth of both genders, varying levels of VI severity, and age. An evaluation of the invariance tests shows support for measurement quality across age level, VI severity, and gender. We next elaborate on some more detailed results to provide a more nuanced explanation of the findings.

For VI severity, the mean score for environmental barriers was lower for participants who reported mild severity compared to those who reported moderate to severe impairment. This finding is consistent with other research suggesting children with mild VI are more likely to find sporting opportunities and experience fewer environmental barriers compared to children who are completely blind or with severe VI (Martin, 2017). The standard deviations for personal, social, and environmental barriers were all higher for individuals with moderate to severe VI severity compared to those with mild VI severity, suggesting a greater diversity of barrier experiences in this group. Last, the correlation between personal and social barriers was significantly lower for those youth with mild VI severity compared to those with moderate to severe VI severity. This suggests that the link between personal and social barriers is much stronger for children with severe VI. Stated differently a youth with severe VI who experiences a social barrier (e.g., lack of social support from a parent) is more likely to also experience a personal barrier (e.g., lack of confidence for PA) compared to a child with mild VI. It is plausible that parent's perceive their children with severe VI as less capable of PA compared to children with mild VI, and therefore provide less social support. In turn, reduced social support leads to greater personal barriers such as a lack of confidence which is often a function of social support, according to social cognitive theory.

Means, variances, and correlations did not vary according to gender indicating boys and girls experienced the three forms of barriers similarly. This finding contrasts with the results of Armstrong et al. (2018) indicating boys had fewer PA barriers compared to girls. The large sample size difference between Armstrong et al. (2018) and the current study is a logical reason that is likely to account for this difference. However, the current findings are consistent with other literature which does not identify a gender bias for PA participation for children with VI (Greguol et al., 2014).

For age the correlation between personal and social barriers was higher for older participants compared to younger participants. This suggests that the link between personal and social barriers is much stronger for older youth compared to younger children. Put differently, an older youth who experiences a social barrier (e.g., lack of social support from a classmate) is more likely to also experience a personal barrier (e.g., lack of confidence) compared to a younger participant. Similarly, the correlation between personal and environmental barriers was also significantly higher for older participants compared to younger children. This indicates that if an older youth with VI experiences an environmental barrier they are also more likely to report a personal barrier compared to a younger child. All of the correlation results among the 3 forms of barriers by gender, age, or VI severity do not allow for cause and effect conclusions. However, based on social cognitive theory it is likely that the links are bi-directional. For instance, lacking confidence may lead to a perception of more environmental barriers. Conversely, if environmental barriers limit opportunities to engage in PA, then success experiences that can generate increased efficacy are also reduced (Humphries et al., 2012).

A few limitations should also be noted. First, our study was conducted with a convenience sample of children with VI who attended summer sports camps. Because these children attended a sports camp they may represent a unique sample that does not generalize to the population. For instance, these children may perceive fewer barriers to PA because they went to a sports camp. They may also have learned how to overcome some of the barriers to sport and PA due to their involvement in these camps. They may also have supportive parents who make it a priority that their children have PA experiences. Given their ability to enroll their children in the camps these parents may also come from a higher Social Economic Status (SES) group than the population at large. Children from rural areas far from the camps were also not likely to attend compared to children from suburban and metropolitan areas. Age was examined as a proxy for reading ability but we did not directly assess reading ability.

In conclusion, we used a CFA to confirm a previously identified three-factor structure for the PABQ-VI and eliminated poorly performing items. This resulted in a psychometrically strong and user-friendly scale that researchers and practitioners can use with confidence.

Table. 1.
Configural Model factor loadings for all PABQ-VI items per the three latent constructs

Item	**Item Wording**	**Factor loading**	
Personal Construct		**Female**	**Male**
PAB1	I believe physical activity is important.	0.883	0.86
PAB2	I feel motivated to do physical activity.	0.675	0.635
PAB3*	I think I have enough time after homework and chores to do physical activity.	0.200	0.336
PAB4	I know ways that I can be physically active.	0.807	0.647
PAB5	I believe I can do physical activity even though I have a visual impairment.	0.931	0.794
PAB6**	Sport and physical activities are fun because I am good at them.	0.577	0.569
PAB7	I feel confident to try new sports and physical activities.	0.774	0.861
PAB8**	I like how my body looks or feels when I do physical activity.	0.571	0.616
PAB9*	I'm scared to get hurt when I do physical activity.	0.227	0.311
PAB10	Physical activity and sports are fun.	0.835	0.878
PAB11*	Physical activity makes me very tired because I have a visual impairment.	0.336	0.385
PAB12*	My vision impairment does not keep me from doing physical activity.	0.785	0.413
Social Construct			
PAB13	My parents have time to do physical activity with me.	0.164	0.268
PAB14*	My parents show me how to do physical activity.	0.375	0.459
PAB15	My parents encourage me to do physical activity.	0.772	0.645
PAB16	My parents can afford for me to do sport and physical activities.	0.763	0.719
PAB17**	My parents expect me to do physical activity.	0.63	0.578
PAB18**	My parents believe that physical activity is just as important as school.	0.613	0.539
PAB19*	My parents worry about my safety when I do physical activity.	-0.138	-0.293
PAB20	Physical activity is important to my parents.	0.789	0.63
PAB21**	My parents have time to take me to sport even if my siblings also play sport.	0.622	0.575
PAB22	My parents have a way to get me to places to do sport or physical activity.	0.785	0.637
PAB23	My classmates include me in games and physical activities during recess.	0.595	0.602
PAB24	I know other children who will do physical activity with me.	0.708	0.625
PAB25**	Other kids have made fun of me during sports or physical activity.	0.411	0.264
PAB26	My teachers expect me to do physical activity just like everyone else.	0.787	0.533
PAB27	My PE teacher encourages me to do physical activity.	0.821	0.745
PAB28*	My teacher worries about my safety when I do physical activity.	-0.279	-0.031
PAB29*	My PE teacher makes changes to games and activities so I can participate.	0.06	0.34
PAB30	My PE teacher includes me in games and physical activities.	0.798	0.71
Environment Construct			
PAB31*	People in my community don't expect that I can do physical activity or sport.	0.314	0.418
PAB32	I know about opportunities to do physical activity in my community.	0.759	0.676
PAB33	There are sport programs or physical activities available in my community.	0.792	0.684
PAB34*	I have access to sighted guides who can help me do physical activity in my community.	0.407	0.132
PAB35	There are sports programs that I can join which are close to home.	0.755	0.628
PAB36	There are places in my community that are safe for me to do physical activity.	0.874	0.815
PAB37	Sports clubs in my community will allow me to join even though I have a visual impairment	0.788	0.688
PAB38	I have sports equipment at home that I can use to be physically active.	0.677	0.531
PAB39	There are spaces at home that are safe for me to do physical activity.	0.666	0.786
PAB40*	I have to participate in PE class because it is a school rule.	0.416	0.320
PAB41*	My school has physical activity equipment for people with visual impairment (e.g. Bell balls, Beep balls, guide wires).	-0.152	-0.161
PAB42	My school has sport teams and physical activity clubs that I can join if I want to.	0.521	0.592

*removed based on the initial configuration model results with gender as the grouping variable. **removed based on the initial configuration model results with age as the grouping variable

Table 2.

Final Selected PABQ-VI items, Construct Composite Reliabilities, and item factor loadings

		Factor loading	
Item	**Item Wording**	**Low**	**Mod-Sev**
Personal Construct		CR = .94	CR = .89
PAB1	I believe physical activity is important.	0.921	0.865
PAB2	I feel motivated to do physical activity.	0.677	0.665
PAB4	I know ways that I can be physically active.	0.821	0.642
PAB5	I believe I can do physical activity even though I have a visual impairment.	0.911	0.778
PAB7	I feel confident to try new sports and physical activities.	0.816	0.797
PAB10	Physical activity and sports are fun.	0.892	0.783
Social Construct		CR = .94	CR = .82
PAB15	My parents encourage me to do physical activity.	0.779	0.518
PAB16	My parents can afford for me to do sport and physical activities.	0.801	0.550
PAB20	Physical activity is important to my parents.	0.757	0.533
PAB22	My parents have a way to get me to places to do sport or physical activity.	0.793	0.570
PAB23	My classmates include me in games and physical activities during recess.	0.717	0.460
PAB24	I know other children who will do physical activity with me.	0.812	0.484
PAB26	My teachers expect me to do physical activity just like everyone else.	0.720	0.686
PAB27	My PE teacher encourages me to do physical activity.	0.891	0.749
PAB30	My PE teacher includes me in games and physical activities.	0.902	0.667
Environment Construct		CR = .91	CR = .81
PAB32	I know about opportunities to do physical activity in my community.	0.721	0.702
PAB33	There are sport programs or physical activities available in my community.	0.751	0.686
PAB35	There are sports programs that I can join which are close to home.	0.708	0.579
PAB36	There are places in my community that are safe for me to do physical activity.	0.896	0.758
PAB37	Sports clubs in my community will allow me to join even though I have a visual impairment	0.839	0.527
PAB38	I have sports equipment at home that I can use to be physically active.	0.669	0.477
PAB39	There are spaces at home that are safe for me to do physical activity.	0.762	0.627
PAB42	My school has sport teams and physical activity clubs that I can join if I want to.	0.670	0.362

Note. These factor loading values and composite reliabilities are based upon the multi-group configural model with visual impairment status as the grouping variable.

Table 3. Model Fit Indices for PABQ-VI two group models

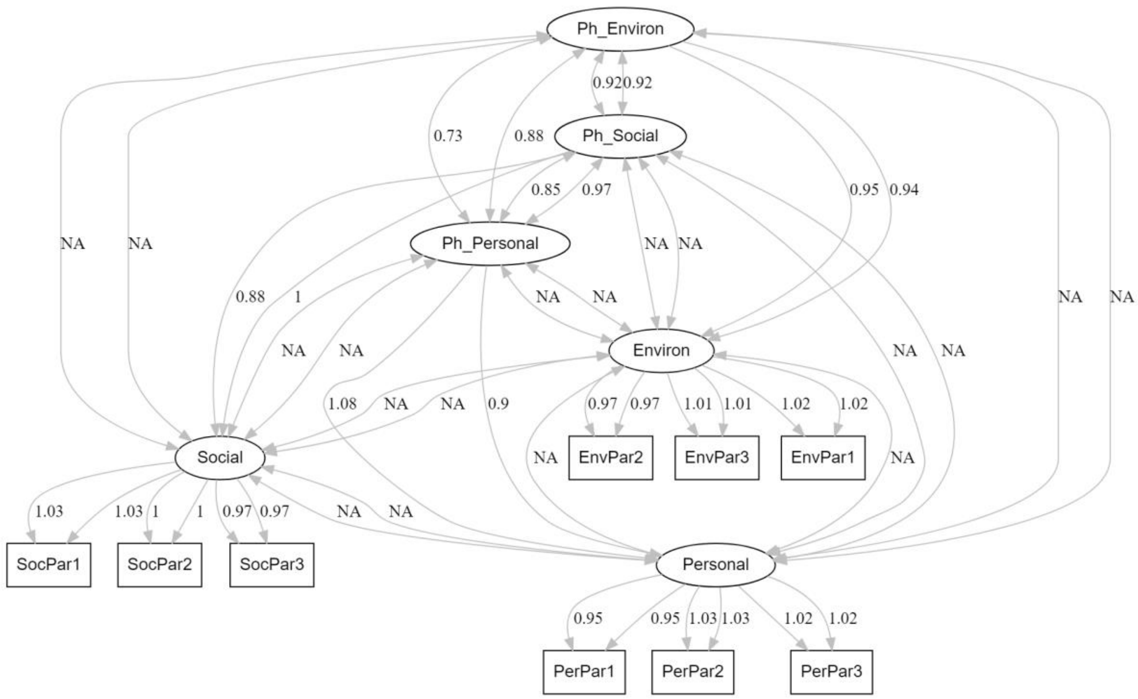
Model Name	χ^2	*df*	Scaling Factor	CFI	NNFI	RMSEA	RMSEA 90% CI	SRMR	ΔCFI	$\Delta\chi^2$	Δ*df*	*p-value*	Tenable?
Null Model	7645.21	1722											
Age Levels (under 13 yoa = 88, 13+ yoa = 153)													
Configural Model – Item Level	1105.024	454	1.122	0.823	0.803	0.116	.107, .124	0.07					
Configural Model – Parcels	106.32	48	1.218	0.961	0.942	0.111	.082, .139	0.037					
Weak Invariance	114.736	54	1.188	0.961	0.948	0.105	.078, .132	0.047	0.000				Yes
Strong Invariance	123.307	60	1.169	0.960	0.952	0.101	.076, .127	0.05	0.001				Yes
Homogeneity of Latent Means	135.368	63	1.151	0.955	0.948	0.105	.080, .129	0.081		11.66	3	<.001	No
Homogeneity of Latent Variances	126.668	63	1.171	0.96	0.951	0.099	0.074, .124	0.085		4.18	3	0.242	Yes
Phantom Model	123.451	60	1.169	0.952	0.96	0.101	.076, .127	0.05		-0.17	0		
Homogeneity of Correlations	134.193	63	1.169	0.955	0.948	0.105	.080, .129	0.114		12.56	3	0.006	No
Visual Impairment level (mild n=140 vs moderation/severe n = 99)													
Configural Model – Item Level	1030.872	454	1.133	.840	.822	0.110	.101, .119	0.066					
Configural Model – Parcels	92.01	48	1.236	.970	.955	0.097	.067, .127	0.040					
Weak Invariance	97.353	54	1.202	.971	.962	0.09	.060, .118	0.043	-0.001				Yes
Strong Invariance	119.406	60	1.179	.962	.954	0.099	.073, .125	0.051	0.009				Yes
Homogeneity of Latent Means	142.418	63	1.165	.949	.942	0.111	.087, .135	0.065		25.14	3	<.001	No
Homogeneity of Latent Variances	142.077	65	1.19	.950	.944	0.109	.084, .133	0.256		13.89	3	<.001	No
Phantom Model	126.074	62	1.174	.959	.952	0.101	.075, .126	0.058					
Homogeneity of Correlations	146.311	65	1.194	.947	.941	0.112	.088, .136	0.148		26.68	3	<.001	No
Gender (male n=118 vs female n =124)													
Configural Model – Item Level	1057.208	454	1.138	0.833	0.814	0.112	.103, .121	0.066					

Configural Model – Parcels	117.867	48	1.272	0.952	0.928	0.124	.096, .152	0.037					
Weak Invariance	123.25	54	1.242	0.953	0.938	0.115	.088, .142	0.042	-0.001		6		Yes
Strong Invariance	131.438	60	1.221	0.953	0.943	0.11	.084, .135	0.045	0.000		6		Yes
Homogeneity of Latent Means	137.493	63	1.21	0.951	0.944	0.109	.084, .134	0.064		5.88	3	0.118	Yes
Homogeneity of Latent Variances	132.334	63	1.225	0.954	0.947	0.106	.080, .131	0.084		1.62	3	0.654	Yes
Phantom Model	131.438	60	1.221	0.953	0.943	0.11	.084, .135	0.045					
Homogeneity of Correlations	135.824	63	1.231	0.951	0.944	0.108	.083, .133	0.053		6.71	3	0.081611	No

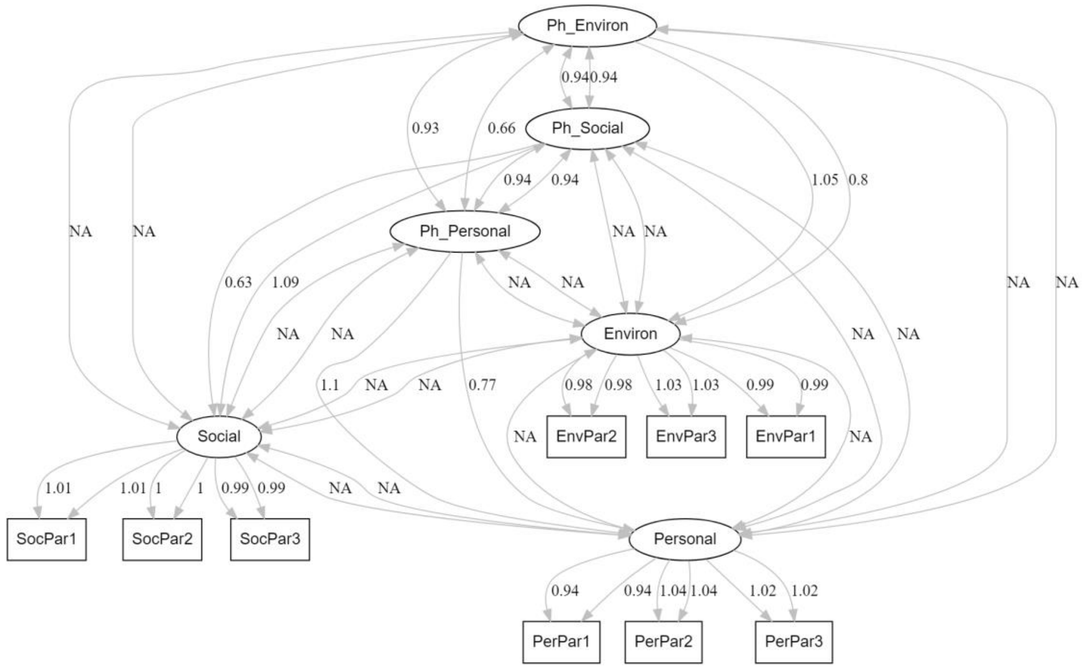
Figure 1.

Final Multi-group Models with Phantom Constructs, Latent Standard Deviations, and Correlations

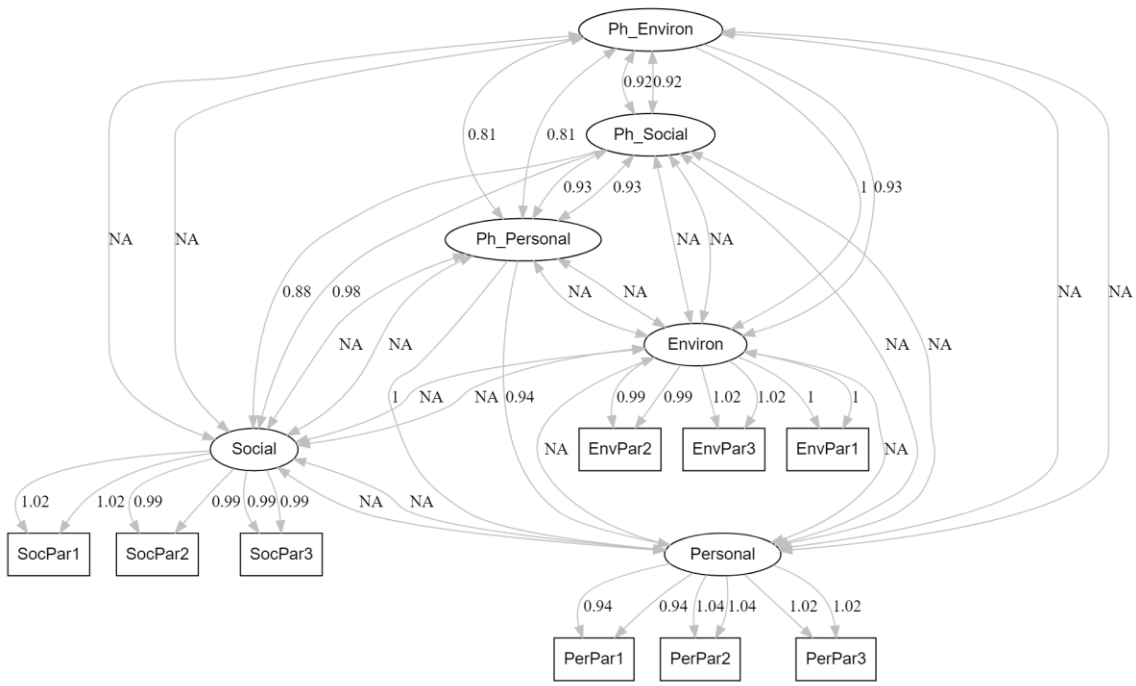
A. Age Level



B. Visual Impairment Level



C. Gender



Note. With the addition of phantom constructs, the correlations for the first-order constructs with each other and with the phantom constructs are not estimated (NA values). The regression from the phantom construct to its respective first-order construct represents the standard deviation of the latent construct; thus, separating the construct variance from the construct correlations at the phantom level.

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Endnote one: Chronologically the first study completed by Armstrong et al. was published in 2020 whereas the second study completed was published in 2018. This discrepancy was due to review time and publishing lag time differences between the journals where each article was ultimately published.