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Narrative Review of validation studies of the versions of the Physical Activity Enjoyment Scale for adolescents and older adults

Introduction

The positive effects of physical activity on physical, cognitive, and mental health are well known (Poitras et al., 2016), yet 80% of adolescents are considered physically inactive (Guthold et al., 2020). Within the different developmental stages of youth, adolescence is particularly important in establishing a lifelong commitment to healthy lifestyles (Batista, 2019), thus contributing to developing physical activity-rich lifestyle habits.

Research consistently confirms that an activity-related motivational system is a key component of physically active lifestyles (Kälbli, 2021; Carl et al., 2020; Dallinga et al., 2018). An essential element in a favorable motivational structure is the regular experience of positive experiences related to physical activity (Révész, 2021), which contributes significantly to achieving adequate physical activity levels (Gu et al., 2018). An important question is in which domain, with what frequency and intensity these positive experiences occur, and how they could be characterized and measured as factors.

The questionnaire method is a widely used scientific approach to exploring different characteristics of young people. It is also true for the enjoyment associated with physical activity among young people (children, adolescents, and youth). The Physical Activity Enjoyment Scale (PACES), developed by Kendzierski and DeCarlo (1991), was designed to measure the level of enjoyment of physical activity among young people using a standard method. It determines motivation for physical activity, including its associated enjoyment, for the preschool and adolescent age groups (Berki & Tarjányi, 2022). Several versions of the PACES have been validated in several countries in school-age children and adult age groups and can be used to measure the enjoyment level of physical activity (Burns et al., 2017; Chen et al., 2021; Román et al., 2014; Jekauc et al., 2013).

The quantity and quality of physical activity among school-age children is paramount for maintaining and developing physical and mental health, given today's increasingly sedentary lifestyles (Mitchell, 2019). According to the 2018 US Physical Activity Guidelines, 3 hours of moderate-to-moderate daily physical activity would be ideal for preschool-age children. Still, inactivity is already common at this age (US Department of Health and Human Services, 2018), and inactivity rates increase steadily with age (Poitras et al., 2016). Physical inactivity in school-age children negatively affects physical fitness and mental and cognitive abilities (Janssen & LeBlanc, 2010; Poitras et al., 2016). For example, Biddle and colleagues (2011) have shown that physical activity benefits children's mental health, so a clear goal for future societies is to ensure that school-age children spend as much time as possible in physical activity.

At the societal level, the frequency and amount of regular physical activity people engage in is strongly influenced by their financial situation and the amount of leisure time they have (Földesiné, 1991). For young children, the role of parents and their attitude towards sport is the most important in encouraging regular physical activity (Holt et al., 2011; Downward et al., 2014). Later on, physical activity can also function as a source of pleasure and a means of releasing free energy (Sterbenz & Géczi, 2016), during which time the role of sports professionals (physical educators, coaches, sports leaders) becomes of paramount importance (Csáki et al, 2013), as the child's liking for the person leading the physical activity sessions, usually the coach or PE teacher, increases the child's commitment to regular physical activity (Rottensteiner et al., 2015).

Motivation, particularly intrinsic motivation, plays a key role in increasing the quantity and quality of physical activity in children (Ng et al., 2012). An essential part of intrinsic motivation for physical

activity is the enjoyment and excitement generated by the physical activity (Owen et al., 2014). It can be most effectively increased for children through different games (Mak et al., 2021). Engagement in and enjoyment of physical activity in children depends to a large extent on the community and peers with whom they can engage in the physical activity, as the majority of young children engage in sporting activity because a friend or classmate is also doing the activity (Gyömbér et al., 2016). In addition to parents and peers, schools (school sports) and teachers are also essential players in this process (Curtis, McTeer, and White, 1999).

The study of motivation is a very complex and challenging area. PACES is a tool to help develop this area, particularly in physical activity. The level of motivation is regulated by both external and internal influences (Várhegyi & Dóczi, 2021); the enjoyment of physical activity can be classified as an internal influence; therefore, by increasing the enjoyment level of physical activity, the intrinsic motivation of the Syrians can be increased (Berki & Pikó, 2018). However, it is also important to stress that not all community or group members can be equally intrinsically motivated to do the same thing (Ryan & Deci, 2000b).

Understanding individual characteristics and differences is essential from a pedagogical point of view, and we have therefore set our study the following objectives:

- A literature review and collection present the PACES questionnaire method's theoretical basis and scientific soundness.
- Seven studies used the PACES questionnaire, a modified, validated version of which was used to measure the level of enjoyment of physical activity in adolescents or adults.

Method

The present study is a narrative (descriptive, not systematic), critically synthesizing English-language articles. As a first step, we conducted a literature search using Google Scholar and PubMed databases. Our keywords were "Physical Activity Enjoyment Scale," "Physical Activity," "Physical Education," "enjoyment," "motivation," and "PACES validation study." In the first step, two researchers collected the literature, identifying the publications (N=17) considered most relevant to the objectives of our study based on the citation indexes. In a second step, we identified the publications (1) in which the authors had validated PACES in a national language. In the second step (2), we summarized the results of the scientific work using PACES and the focal points of this research and used the selected (N=7) publications to present this research area.

The PACES is a questionnaire method, the original version containing 18 statements rated by the participants on a 7-point Likert scale. Over the years, the questionnaire and its modified versions have been validated in several languages. Some versions of the PACES differ from the original questionnaire either in the number of items included in the Likert scale (Dunton et al., 2009) or both (Motl et al., 2000). The different PACES versions are similar in that the statements are divided into two poles, and the number of negatively worded statements is less than that of positively worded statements.

Results

The first step of our results was to classify the selected studies (Table 1). Of the seven studies, one was written in the 1990s, 2 in the 2000s, and four after 2010. 5 deal with the school environment, 1 with the sports environment, and 1 with other settings. Sample sizes varied between N=57 and N=5934. In terms of research methodology, four versions of the questionnaire were used. Regarding age groups, most surveys (N=6) covered people under 20 and (N=1) those aged 60-91.

Summary of the validation studies analyzed

Year Method Population Country/language Age Sport Key conclusions
1995 confirmatory factor analysis, consistency test (Cronbach's alpha) 392 USA 10-17 years basketball, football, tennis The measurement tool showed a good fit, but it is one-dimensional, so much depends on how the claims are formulated.

2008 multivariate analysis of variance (MANOVA), consistency testing 5934 Italy 11-19 years physical education in school The Italian version of the PACES has high internal consistency and reliability. It can be used effectively to assess the enjoyment and pleasure of physical activity in a physical education classroom setting. 2009 confirmatory factor analysis, structural equation modeling 387 USA 15-18 years physical education in school Despite the gender differences, the single-factor study confirmed the usefulness of the PACES as an effective measure of physical activity enjoyment.

2013 confirmatory factor analysis (CFA), consistency test (Cronbach's alpha) Study 1: 504, Study 2: 196 Germany 9-17 years physical education in school The German version of PACES is reliable; however, the factorial validity and invariance of the measure can only be partially verified.

2019 univariate normality analysis, confirmatory factor analysis (CFA) 4051 China 9-20 years physical education in school The comparison tests found a significant correlation between gender and the three levels of education studied and confirmed the one-dimensionality of the questionnaire. The analyses also confirmed the applicability and reliability of the Chinese version of the instrument.

2018 confirmatory factor analysis (CFA), fit analysis (chi-square/df, SRMR, RMSEA), comparative fit analysis (CFI) Study 1: 168. Study 2: 57 Brazil 60-91 years general sports The Brazilian Portuguese version of PACES effectively measures the enjoyment level of physical activity; with this instrument, the measurement results are almost perfectly reproducible over a 7-14 day interval.

2021 content analysis, exploratory factor analysis, consistency check Study1: 182, Study 2: 3219 Germany 11-17 years physical education in school The PACES-S is a reliable and valid measurement method that can be particularly useful for measuring physical activity enjoyment in large-scale studies. However, its main limitation is that its effectiveness has only been tested in a German-speaking population.

Table 1: Key data from the validation studies analyzed

Summary of the validation studies analysed

Year	Method	Population	Country/language	Age	Sport	Key conclusions
1995	confirmatory factor analysis, consistency test (Cronbach's alpha)	392	USA	10-17 years	basketball, football, tennis	The measurement tool showed a good fit, but it is one-dimensional, so much depends on the way the claims are formulated.
2008	multivariate analysis of variance (MANOVA), consistency testing	5934	Italy	11-19 years	physical education in school	The Italian version of the PACES has high internal consistency and reliability and can be used effectively to assess the level of enjoyment and pleasure of physical activity in a physical education classroom setting.
2009	confirmatory factor analysis, structural equation modelling	387	USA	15-18 years	physical education in school	Despite the gender differences, the single-factor study confirmed the usefulness of the PACES as an effective measure of physical activity enjoyment.

2013	confirmatory factor analysis (CFA), consistency test (Cronbach's alpha)	Study 1: 504 Study 2: 196	Germany	9-17 years	physical education in school	The German version of PACES is reliable, however, the factorial validity and invariance of the measure can only be partially verified.
2019	univariate normality analysis, confirmatory factor analysis (CFA)	4051	China	9-20 years	physical education in school	The comparison tests found a significant correlation between gender and the three levels of education studied and confirmed the one-dimensionality of the questionnaire. The analyses also confirmed the applicability and reliability of the Chinese version of the instrument.
2018	confirmatory factor analysis (CFA), fit analysis (chi-square/df, SRMR, RMSEA), comparative fit analysis (CFI)	Study 1: 168 Study 2: 57	Brazil	60-91 years	general sports	The Brazilian Portuguese version of PACES effectively measures the enjoyment level of physical activity and with this instrument the measurement results are almost perfectly reproducible over a 7-14 day time interval.
2021	content analysis, exploratory factor analysis, consistency check	Study1: 182 Study 2: 3219	Germany	11-17 years	physical education in school	The PACES-S is a reliable and valid measurement method that can be particularly useful for measuring physical activity enjoyment in large-scale studies, however, the main limitation of the PACES-S is that its effectiveness has only been tested in a German-speaking population.

Review of validation studies of the Physical Activity Enjoyment Scale

Crocker and colleagues (1995) carried out one of the first validations of the original PACES questionnaire developed by Kendzierski and DeCarlo (1991). In this validation study, the 18 items of the PACES were rated on a 7-point Likert scale. On the 7-point scale, the statements were divided into two opposite poles. The maximum score was 126, and the minimum score was 18.

The original sample was 392 youth sports camp participants aged between 10 and 17. There was some concern among the authors that younger participants might not understand or be clear about all the statements in the PACES. In order to more accurately define the sample, it was decided to exclude all participants aged 10 and 11, as well as those who lacked any knowledge of the sports chosen to conduct the study. Furthermore, due to their small size (n = 17), all 17-year-olds were excluded from the sample. The final sample was 279 (159 males and 120 females) with an average age of 14.4 years. Participants played boys' and girls' basketball, boys' and girls' football and tennis.

The research aimed to determine the minimum number of factors underlying the observed variables (gender differences, differences between different ages, or years of schooling). The fundamental objective was to test the original PACES questionnaire on a sample with a mean age of 14 years using factor analysis and Cronbach's alpha coefficient for consistency. The statistical analysis showed that the questionnaire was valid with a high confidence value of α=0.96.

In the sample analysis, the correlation value ranged from r = 0.38 to r = 0.76. The internal consistency assessed by Cronbach's alpha coefficient was α = 0.90. These results were similar to those of Kendzierski and DeCarlo (1991), the developers of PACES. Interestingly, no gender differences were found in the questionnaire analysis. The results obtained suggest that the proposed structure of the PACES was a good fit. Due to its one-dimensional structure, several research questions have been raised, particularly concerning measuring enjoyment. One issue is the rating scale of the statements within the PACES.

The original version of the PACES has undergone several minor modifications, but Dunton and colleagues (2009) validated a version of the questionnaire on the most significant sample of items. The original version of the PACES was used (Kendzierski & DeCarlo, 1991), with the modification that the 18 items assessing enjoyment of the exercise (e.g., "I think it's pleasant," "Very stimulating," "It feels good,") were rated on a 6-point scale rather than 7. Participants were asked to respond to each statement on a 6-point scale (1 = strongly disagree, 6 = strongly agree). Seven statements were negatively worded (e.g., "Not fun at all," "I don't like it," "It frustrates me"). Consideration was also given to previous research that supports the factorial and construct validity of the PACES among secondary school girls (Motl et al., 2001) and children (Paxton et al., 2008).

Dunton and colleagues' (2009) research aimed to examine the factorial validity and gender invariance of the PACES in a sample of older adolescent boys and girls (ages 15-18). The primary objective of the research was to determine the wording of the questionnaire statements to ensure that they were applicable and valid in younger populations. Secondarily, the researchers sought to determine whether the factor structure, item ratings, and item errors were equal for boys and girls.

The study involved 387 secondary school students. The students were recruited from a suburban high school in the northeastern US. The participants were in 10th grade. They participated for over one year until the start of 11th grade. For practical reasons, adolescents enrolled in special classes (e.g., severe learning disabilities, English as a second language) were not included in the study sample (Dunton et al., 2009).

There were no significant differences in age, gender, and ethnicity data for the PACES questionnaire (n = 21). There were also no significant differences between those who answered all questions and those who did not answer all questions (n = 366). Therefore, the researchers also accounted for some data being missing by chance. Individual mean scores for statements ranged from 4.06 to 5.68 (on a 6-point scale). Boys (M = 4.98, SD = 0.77) and girls (M = 4.88, SD = 0.84) had comparable cumulative gender mean scores when using PACES: $t(364) = 1.15$, $p = 0.252$.

The results showed that the fit of the single-factor model was correlated with error terms and positively worded items. These did not impair or limit the evaluability of the various data (e.g., factor loadings and correlations between error terms). Despite gender differences in physical activity levels (Grunbaum et al., 2004), the single-factor test is equally and effectively used. It is essential to note that the measurement should be standardized because if the questionnaire works differently for boys and girls, it may confound the interpretation and evaluation of research results (Horn & McArdle, 1992).

Jekauc and colleagues (2013) conducted a German validation of the PACES adapted from Motl and colleagues (2000) in their study. The PACES developed by Motl et al. (2000) contains 16 statements, starting with "When I am physically active..." The response categories were shortened to a 5-point Likert scale. The authors aimed to investigate reliability, factor and criterion validity, and measurement invariance between age and gender for the German version of the PACES in the German-speaking child and adolescent population. One of the aims of the authors' study was to resolve the problem of contradictory gender invariance results reported by Moore et al. (2009) and Dunton et al. (2009). The authors conducted two consecutive studies. Based on responses to questionnaire disguises, confirmatory factor analyses were applied to a cross-sectional sample of 250 girls and 254 boys (Study 1) and a longitudinal sample of 109 boys and 87 girls (Study 2). Both studies involved students aged 9-17.

Correlation at 7-day intervals assessed test-retest reliability. Cronbach's alpha and the composite reliability coefficient based on CFA assessed internal consistency. Participants in the first study were 250 girls and 254 boys aged 9-17 years (M=13.9; SD=2.2), who also served as the sample for the MoMo study (Motorik-Modul). The MoMo study is a representative study conducted in Germany among children and adolescents aged 9-17 (Woll, Kurth, Opper, Worth, and Bo¨s, 2011). In this first study, four different factors were used to model the reliability of the questionnaire. The resulting scale averages, confidence intervals, standard deviations, Cronbach's alpha coefficient, and the results of the composite reliability analysis indicated that Cronbach's alpha coefficient ranged between 0.92 and 0.93, indicating that the internal consistency of the questionnaire was considered good.

In Study 2, 109 boys and 87 girls participated, all aged 9-17 years (M=12.8; SD=1.6). Participants were collected from secondary schools in Konstanz, Germany, from all three types of schools in the three-tier secondary school system: Hauptschule (n=28), Realschule (n=63), and Gimnázium (n=105).

Cronbach's alpha coefficient in this analysis ranged from $\alpha = 0.89$ to 0.91. This validation study showed that the German version of the PACES is sufficiently reliable and comparable to the original English version (Jekauc et al., 2013). The researchers agreed that the factorial validity and invariance of the measure can only be partially confirmed based on previous research results because the method's effect depends on how positive and negative items and statements are formulated.

The PACES is a well-known and used measurement instrument in Europe and worldwide, especially in Asian countries, as the questionnaire has been validated in several studies in China (Chen et al., 2019; Chung & Leung, 2018; Chen et al., 2021). Chen et al. (2019) conducted the first version of the questionnaire validated in Chinese based on the version developed by Motl et al. (2001). The validation survey involved N = 4051 (originally 4074, remaining 4051 after data cleaning) students aged between 9 and 20 years. All students were enrolled in 37 primary and secondary schools in 37 public institutions in 8 different geographical areas of Mainland China. 50.5% of the participants were boys and 49.5% were girls. At least one trained administrator was present in each school to ensure the study was conducted properly. The students participated in the study voluntarily and completed the Chinese version of the PACES (S-PACESC) in a classroom setting.

The study's primary aim was to validate the Chinese version of the PACES questionnaire by demonstrating factor validity, measurement equivalence, and predictive validity. Previous studies have well documented the importance of enjoyment of physical activity in physical education class participation (Sallis et al., 1999; Schneider et al., 2009; Williams et al., 2008). Based on these, the authors found that an accurate and valid measure can be conducted using their questionnaire version. The two-way MANOVA results revealed a significant correlation between gender and school grade using Wilks' statistical coefficient. Separate univariate ANOVA parameters revealed a significant association between gender and level of enjoyment of exercise. Separate univariate ANOVA parameters also found a significant association between the level of enjoyment of physical activity and the school year. These findings suggest that gender and educational attainment should be included as covariates.

In a study by Chen and colleagues (2019), measurement equivalence and latent mean comparison tests found significant associations between gender and the three levels of education. The results also support the unidimensional nature of the PACES and the validity and applicability of the Chinese version of the questionnaire. Chen and colleagues (2021) adapted and created a shortened version of the PACES, which they named PACES-S. This version of the questionnaire was designed with 16 items instead of the original 18 items, which can be rated on a 4-point Likert scale instead of the original 7 (Chen et al., 2021). They wrote their study with the two aims of (a) creating a new, shortened version of the PACES using content analysis and (b) validating the applicability of their new version of the PACES (Chen et al., 2021) to an adolescent (11-17 years old) sample by examining the psychometric properties of the new PACES-S questionnaire (validity, internal consistency, test-retest reliability, and concurrent validity).

The content analysis was conducted by six researchers, four of whom had PhD degrees in sports sciences, based on the work of Lynn (1986), who stated that a minimum of five researchers are required for content analysis to ensure that matches are sufficiently verifiable (Chen et al., 2021). The content validity index was determined based on Scherer's (1987) component process model. When evaluating the 16 statements in the questionnaire, the researchers paid close attention to evaluating negatively worded statements (Chen et al., 2021). A modified 4-point Likert scale (1 = "does not meet the definition"; 2 = "somewhat meets the definition"; 3 = "fairly meets the definition"; 4 = "very meets the definition") was used to assess the content validity of the statements (Jekauc et al., 2013), based on the work of Davis (1992). The content analysis researchers chose the following for each value on a 4-point Likert scale of statements based on content validity: 'I enjoy,' 'I find it pleasant,' 'Very pleasant,' and 'It feels good.' The k* of the four selected items was higher than 0.74, which was used in the PACES-S.

The researchers' internal consistency, test-retest reliability, construct—and concurrent validity of the newly created German-language PACES-S were assessed using data from two coherence studies (Jekauc et al., 2013; Mauz et al., 2020) (Chen et al., 2021). The enjoyment level of the sample subjects was examined in two separate studies (Chen et al., 2021). The first study (Study 1) investigated a sample of 182 members (N=182), consisting of 103 males (n=103) and 79 females (n=79) (Chen et al., 2021). All sample members were from a German city's regular secondary schools, from all three types of traditional secondary schools: Hauptschule, Realschule, and Gimnázium (Chen et al., 2021). They also completed the MoMo-PAQ physical activity questionnaire and the PACES-S questionnaire developed by Chen et al. (2021) on two measurement occasions, with 7 days between each measurement. During this 7-day measurement period, all subjects wore an ActiGraph GT1M (Pensacola, FL, USA) accelerometer and kept a physical activity diary.

To replicate the reliability and validity analysis of the PACES-S, Mauz et al. (2020) based on the tests and results of Study 1 and the psychometric properties of the PACES-S were also evaluated using the measurement data from Study 2 (Chen et al., 2021). For this second study, the researchers chose a sample of adolescents aged 11-17 who participated in the German KiGGS national fitness measurement similar to the Hungarian NETFIT measurement between 2014 and 2017 (Woll et al., 2021). After providing their data (age, gender, type of school) and being assessed for physical fitness, participants completed the PACES-S questionnaire developed by Chen et al. (2021) on several occasions (Wagner et al., 2014). They wore an accelerometer for 8 days to assess their physical activity (Chen et al., 2021).

Exploratory and confirmatory factor analysis identified and confirmed the factorial validity of the PACES-S. Results showed good test-retest reliability (r = 0.76) and internal consistency (α = 0.82-0.88). In this context, in addition to parallel validity, the results showed positive correlations with the physical activity questionnaire (Study 1: r = 0.36), physical activity diary (Study 1: r = 0.44), and accelerometer data (Study 1: r = 0.44). Study: r = 0.32; Study 2: r = 0.21). A study by Chen and colleagues (2021) using a relatively large sample (Study 2) and a smaller sample (Study 1) investigated the psychometric properties of the PACES-S.

The results show that PACES-S is a reliable and valid measurement method that can be particularly useful for measuring the enjoyment of physical activity in large-scale studies. The shortened German PACES-S shows comparable measurement properties to the original PACES (Kendzierski & DeCarlo, 1991). However, the authors of the validation study point out that there are limitations to their PACES-S (Chen et al., 2021). They mention that, as a limitation, the study of emotions using quantitative measurement methods remains controversial within the scientific community (Barrett, 2006), and the results obtained are based only on studies of German-speaking participants.

In their study, Alves and colleagues (2018) adapted and validated the Brazilian Portuguese version of the PACES. Their study involved 75 subjects and used a test-retest method to assess the data and the internal consistency of the questionnaire. To test the reproducibility of the questionnaire measurement, the researchers performed an intraclass correlation coefficient analysis (Alves et al.,

2018). In this validation study, Alves and colleagues (2018) validated a Brazilian Portuguese adaptation of the original version of the PACES developed by Kendzierski and DeCarlo (1991): 18 statements rated on a 7-point scale (1 = "enjoy," 7 = "hate," 4 = "neutral"). The scores for each statement are summed to give a score, with a maximum score of 126 and a minimum score of 18 (Alves et al., 2018), giving a one-dimensional measure of enjoyment of the physical activity. The questionnaire was translated in 4 stages, following the method developed by Beaton et al. (2007): in the first stage, two translators translated the original English questionnaire into Brazilian Portuguese, one of whom was familiar with PACES and the other not (Alves et al., 2018); in the second stage, a third translator checked the versions prepared in the first stage, and in the third stage, a native English speaker - but fluent in Brazilian Portuguese - translated it back into English. In the fourth stage, all the pre-translations and materials were reviewed by the study's authors and used to produce the final version of PACES in Brazilian Portuguese, using the method of Stork et al., 2015.

The Brazilian Portuguese version of PACES showed very high scores on the reproducibility test (CCI = 0.910, 95% CI 0.858, 0.943), which also demonstrated the effectiveness of the translation method (Alves et al., 2018). Based on the results of this study, the researchers concluded that the Brazilian Portuguese version of the PACES was effective in measuring physical activity enjoyment levels and that the measurement results were almost perfectly reproducible over a 7-14 day time interval using this measure (Alves et al., 2018).

Carraro et al. (2008), in their validation study of the Italian version of the PACES, "*assessed the factorial invariability and reliability between gender and age in a sample of Italian students*[1][1]".

Participants in the study were selected from lower and upper secondary schools in the Northeastern region of Italy, with a total of N = 5934 (3079 girls, 2855 boys) aged 11-19 years (Carraro et al., 2008). During data collection, the questionnaire was completed by students at the end of physical education classes in a relaxed environment without the presence of a physical education teacher (Carraro et al., 2008). During data analysis, the sample was divided into four subcategories according to age and gender, and confirmatory factor analysis was performed on these subcategories.

During the data analysis, the researchers removed univariate or multivariate outliers from the sample. Thus, 84 individuals were removed from the original sample to form the final sample of 5934 individuals (Carraro et al., 2008). Multivariate analysis of variance (MANOVA) was conducted to examine differences in sex and age. The fit parameters of the data and their comparison were examined using an RMSEA indicator based on Hu and Bentler (1999). In the internal consistency test, the Italian language PACES Cronbach's alpha index showed values between .78 and .89, i.e., the instrument under study had strong internal consistency. Also, it showed a good fit for gender and age (Kelloway, 1998). Based on the results of this validation study, it can be concluded that the Italian version of the PACES has high internal consistency and reliability and can, therefore, be used effectively to assess the level of enjoyment and pleasure of physical activity in a physical education classroom setting (Carraro et al., 2008). The authors point out that understanding the relationship between the motives for the enjoyment of physical activity revealed in this study and other psychological variables associated with physical activity may help to inform future intervention strategies (Carraro et al., 2008).

Summary and future directions for development and research

The validation studies analyzed in this research explored the applicability of the Physical Activity Enjoyment Scale (PACES) to scientific measurement. They focused on validating different questionnaire versions across different populations and cultures. However, research on the questionnaire has a much broader spectrum, as it is not limited to its practical applicability. As a

[1] Carraro, A. & Young, M. C. & Robazza, C. (2008). A contribution to validating the physical activity enjoyment scale in an Italian sample. *Social Behavior and Personality*: An international journal, 36(7), 913.

measurement tool, the PACES can also investigate the relationship between physical activity and enjoyment in different cultures and populations.

Crocker and colleagues (1995) validated the PACES in a study of adolescent youth in a sporting environment. They also concluded that enjoyment and its level can significantly influence participation motivation for a given physical activity (Crocker et al., 1995).

Chen and colleagues (2019) focused their study on validating the Chinese version of the PACES and obtained significant results on the factorial validity of the questionnaire. The Chinese-language version of the questionnaire they created is widely applicable – even considering the limitations identified by Jekauc and colleagues (2013) –and can be used in large-scale research (Chen et al., 2019).

A study by Dunton and colleagues (2009) examined the factorial validity of the questionnaire and gender invariance among older adolescent youth. The results showed that the scale is equally applicable to both genders.

Carraro and colleagues (2008) tested and validated the questionnaire on an Italian-speaking population, thus contributing significantly to PACES' international usability and relevance in scientific measurement.

Chen and colleagues (2021) developed and validated a shortened version of the PACES. Their study investigated the questionnaire's psychometric properties to extend its usefulness to other contexts.

Jekauc and colleagues (2013) carried out a reliability and validity study of the German version of the PACES, confirming the scale's applicability to the German population and identifying several limitations of their German version of the questionnaire that may exist for several versions of the questionnaire (Weyland et al., 2024).

The international existence of the PACES is further strengthened by the existence of a validated version in Brazilian Portuguese, which can be attributed to Alves et al. (2018). Their study validated the Brazilian-Portuguese version of the questionnaire and presented the evolution of PACES as a measurement tool in its international practical application.

Based on the data and results presented in this descriptive article, there are still many opportunities for future research and development in PACES. To further develop the questionnaire, it would undoubtedly be worthwhile to explore the scale's applicability to additional cultural and social groups in further research, if only because sports culture has a fundamental impact on the sense of enjoyment derived from physical activity (Malina, 2009), and this impact varies from country to country. A possible and forward-looking direction for future development is to conduct various longitudinal studies using PACES, which could help to understand how physical activity enjoyment varies over time and what factors might influence this variation.

As seen from the seven validation studies I have presented, the PACES can be used to assess different physical activity programs and has been used for this purpose in some cases (Jekauc et al., 2013). However, applying the questionnaire (or a newer version developed for this purpose) to a broader range of age and ability groups may also be suitable for future use in evaluating specific physical activity programs and identifying key elements of successful programs. Of course, we cannot forget the impact of technology and digitalization today. Developing a digital version of PACES, which could, in particular, significantly speed up data capture and processing and its application in research, would provide an opportunity to better understand the impact of modern technologies (e.g., apps and smart devices) on physical activity and enjoyment.

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