The children's perceived locus of causality scale for physical education

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Development and Validation of a Children's Perceived Locus of Causality Scale for Physical Education

Low levels of physical activity in both children and adults are a worldwide issue of concern (Cavill, Kahlmeier, & Racioppi, 2006; Dollman, Norton, & Norton, 2005; Guthold, Cowan, Autenrieth, Kann, & Riley, 2010; USDHHS, 2008). The International Health Behaviour in School-aged Children (HBSC) study found that less than two-thirds of all young people reported participating in sufficient physical activity to meet the guidelines of 60 minutes or more of activity a day on at least 5 days a week (WHO, 2004). Various systematic reviews have underscored the benefits of physical activity among children (Brown & Summerbell, 2009; Janssen & LeBlanc, 2010; Tremblay et al., 2011), and it is, therefore, important that engagement in physical activity is promoted. Towards this end, school physical education (PE) presents a valuable setting (Cavill, Biddle, & Sallis, 2001; Corbin, 2002; WHO, 2007) through which the majority of children can be reached.

PE alone cannot provide children with sufficient activity to meet the guidelines. A recent review of studies involving 6 to 18 year old children PE was found to account for approximately 8.7% - 23.7% of daily steps in boys, and 11.4% - 17.2% in girls (Tudor-Locke, McClain, Hart, Sisson, & Washington, 2009), suggesting PE can make an important contribution to students' overall activity. Furthermore, research has indicated that children may be more active after school on days on which they had PE (Dale, Corbin, & Dale, 2000; Morgan, Beighle, & Pangrazi, 2007). Despite these positive findings, research has demonstrated that as children mature, interest in PE tends to decline, and participation levels decrease (Van Wersch, Trew, & Turner, 1992)

It is important to know how activity levels can be optimised, and how a transfer from physical activity in PE to leisure time settings can be facilitated. A valuable framework toward this end is provided by self-determination theory, which endeavours to explain

motivated behaviour by considering both the ‘quantity’ and the ‘quality’ of motivation (Deci & Ryan, 2000). Students with high levels of self-determined motivation, compared to those with low levels, have been found to be more active during PE and engage in more self-initiated physical activity (Lonsdale, Sabiston, Raedeke, Ha, & Sum, 2009). In line with this, intervention studies based on self-determination theory have shown that when students’ motivation is targeted in PE, activity levels during PE (Tessier, Sarrazin, & Ntoumanis, 2010) and intentions to be active in leisure-time can be enhanced (Chatzisarantis & Hagger, 2009).

Self-determination theory distinguishes between three types of motivation; intrinsic motivation, extrinsic motivation and amotivation. With *intrinsic motivation*, the most self-determined form of motivation, behavioural engagement is driven by personal interest, enjoyment and choice, in the absence of external contingencies. Not all activities are inherently interesting, and individuals often engage in behaviours to obtain separable outcomes. Therefore, four forms of extrinsic motivation are forwarded. Under the least self-determined form, *external regulation*, behaviours are performed exclusively for reasons external to the activity. Examples include fulfilling an external demand, achieving a reward, or avoiding punishment. When feelings of pressure emerge from within the individual and not from the environment or significant others, behavioural engagement is energised by *introjected regulation*. Positive outcomes such as approval and contingent self-esteem are sought and it is aimed to avoid negative outcomes such as feelings of shame or guilt. *Identified regulation* entails engagement in behaviours because the relevance of engagement is understood and the related outcomes are valued (Deci & Ryan, 2000). Behavioural engagement is energised from within the individual, but the behaviour is performed for an external reason, and therefore, identified regulation represents a self-determined form of extrinsic motivation (Deci & Ryan, 2000). Lastly, with the most self-determined from of extrinsic motivation, *integrated regulation*, individuals engage in behaviours because they are

regarded as an important part of their identity, and consistent with personal values, goals and needs. The different forms of behavioural regulation can be viewed in terms of a continuum, ranging from more to less self-determined. When individuals start to value engagement in a behaviour that was originally performed for external reasons only, its regulation can be internalised, thereby becoming more autonomous in character (Deci & Ryan, 2000).

The motivational continuum has been largely applied in research in PE. Self-determined forms of motivation have consistently been related to constructive outcomes, such as interest (Goudas, Biddle, & Fox, 1994), self-esteem (Standage & Gillison, 2007), teachers' rating of effort and persistence (Standage, Duda, & Ntoumanis, 2006), and performance (Boiche, Sarrazin, Grouzet, Pelletier, & Chanal, 2008).

An individual who is neither intrinsically, nor extrinsically motivated, but has a lack of intention to act, is considered amotivated. Amotivation can emerge when it is believed that a behaviour will not result in the desired outcomes or when engagement is not valued, which can cause feelings of incompetence (Ryan & Deci, 2000). In leisure-time physical activity settings amotivated individuals are likely to drop out. In contrast, primary school PE is generally compulsory. Amotivation in PE has been positively related to low involvement, efforts to avoid attendance, and limited intention to be physically active in the future (Ntoumanis, Pensgaard, Martin, & Pipe, 2004), and negatively related to constructive motivational orientations (Vlachopoulos, Katartzi, & Kontou, 2013).

While a large number of studies have investigated the effects of physical activity interventions implemented through PE, and the transfer of effects to leisure time settings, only a limited number of studies have investigated the transfer of motivation between the two settings. In studies omitting to take motivation into account, the positive impact of school-based physical activity promotion on leisure-time activity levels has received mixed support (Kriemler et al., 2011). Compared to PE, more barriers exist to leisure time physical activity

participation, including environmental, time, transport, and monetary constraints. It is likely that these potential constraining factors limit the transfer of physical activity levels. A more pronounced transfer effect can be expected for motivation. Supporting this, the limited number of studies that has investigated such transfer effects have identified a relationship between levels of self-determined motivation in PE and in leisure-time physical activity (Hagger et al., 2009; Hagger & Chatzisarantis, 2007; Standage, Gillison, Ntoumanis, & Treasure, 2012). Furthermore, motivation in PE has been related to self-reported physical activity levels in leisure-time (Cox, Smith, & Williams, 2008; Hagger & Chatzisarantis, 2007). Thus, enhanced motivation likely facilitates increased interest and persistence (Standage et al., 2006), even if engagement is not mandatory (Hagger et al., 2009), as in PE. It may help students overcome barriers to leisure time physical activity participation. Despite these positive findings, very limited is known about primary school-aged children's motivation in PE, as most studies have focussed older samples. Results of research performed in the academic setting, however, suggest that the behavioural regulations are also relevant when primary school-aged children are concerned.

One of the earliest studies applying self-determination theory focussed on the third to sixth grade of primary school, which typically involves 8 to 12 year old students (Ryan & Connell, 1989). It was found that these young children already differentiated between external, introjected, and identified regulation, and intrinsic motivation, and that these behavioural regulations were associated with outcomes such as interest, value, and effort (see Ryan & Connell, 1989). Furthermore, third grade students (typically 8-9 year old) have been found to differentiate between intrinsic motivation, identified regulation, and controlled regulation (aggregate measure of external and introjected regulation) in relation to specific school subjects (Guay et al., 2010). Integrated regulation is not generally investigated in research in PE. It has been suggested that this form of behavioural regulation is not generally

encountered in children, as they are likely too young to have developed a coherent sense of the self, in which the identification with the importance of a behaviour can be assimilated (Vallerand, 2001). Integrated regulation will not be further discussed in this study.

It can be expected that also in relation to PE children differentiate between the behavioural regulations, at least from the third grade onward. Self-determination theory regards intrinsic motivation, as an innate, natural tendency towards the exploration of the environment, mastery, and spontaneous interest (Ryan & Deci, 2000). Intrinsic motivation likely is a factor of importance in relation to PE participation at any age, and in line with this, primary school-aged children often report enjoying PE (Dollman et al., 2005). However, children as young as kindergarten age enjoy some physical activities more than others (Sanders & Graham, 1995). This implies that already at a young age children have motives other than enjoyment for engagement in PE. The significance of physical activity is largely emphasised in the modern society. Identification with the importance of physical activities is, therefore, likely to play a role in children's motivation toward PE (identified regulation). In a qualitative study involving 10 and 11 year old children, health benefits were one of the four subthemes that emerged as children's self-reported reasons for engagement in active play (Brockman, Jago, & Fox, 2011). Approval from peers and contingent self-esteem (introjected regulation) may also be important motivating factors in primary school PE. Physical activity participation has been found to be associated with social status in 10 and 11 year old children, particularly among boys (Jago et al., 2009). Apart from this social evaluation, in any school setting students are evaluated and marked by the teacher. Children may be motivated to participate in PE, just to get a good grade (external regulation). Lastly, it is likely that a minority of children do not perceive PE as valuable (amotivation).

Based on these postulations, and previous research in the academic domain (Guay et al., 2010; Ryan & Connell, 1989), it seems prudent to assess behavioural regulations in PE

involving children 8 years and over. The limited research attention devoted to this matter since Ryan and Connell's (1989) initial research may be partially due to the lack of developmentally appropriate measurement methods. Ryan and Connell (1989) developed a measure suitable for the assessment of behavioural regulations in primary school aged-children, in academic settings; the Academic Self-Regulation Questionnaire (ASRQ). This measure was adapted by Goudas and colleagues (1994) to apply to PE, resulting in the Perceived Locus of Causality scale (PLOC). However, the validity of the PLOC scores has only been evaluated in children aged 11 years and older (Wang, Hagger, & Liu, 2009). No questionnaire is available for the assessment of younger samples in PE, despite evidence that when age-appropriate measures are used, self-report methods can be applied successfully in children 8 years and older (Rebok et al., 2001; Riley, 2004). The present study aims to fill this gap by analysing the PLOC's suitability for use in 8 to 12 year old PE students using qualitative (Study 1) and quantitative methods (Study 2). As the wording of the PLOC and the ASRQ is largely identical, and the ASRQ has been validated in third to sixth grade students (Ryan & Connell, 1989), it was hypothesised that children 8 years and older would be able to express their personal motives for engaging in PE on the PLOC.

Study 1

Participants

Fifteen children between the ages of 8 and 12 years (9 boys, 6 girls), all living in an Australian city, were recruited. A purposive sampling strategy (Kerlinger, 1986) was applied in an attempt to account for variations in nationality, culture, and socio-economic status. A lower age-limit of 8 years was selected based on suggestions of previous work. To cover the entire pre-adolescent period, 12 years was set as the upper age-limit.

More boys than girls participated in this first part of the study, which largely focussed on children's ability to read and comprehend the items. Sex differences have not consistency

been found in children's verbal abilities (Wallentin, 2009), and if differences are found girls generally outperform boys (e.g. in reading) (Logan & Johnston, 2010). Therefore, the sample's unequal distribution over sex was not thought to have impacted upon the results.

Measures

Perceived Locus of Causality Scale (PLOC; Goudas et al., 1994). Based on the ASRQ, the PLOC provides a PE specific measure to evaluate students' behavioural regulations. Amotivation was not originally tapped by the ASRQ, and to include this construct, a subscale derived from the Academic Motivation Scale (AMS, Vallerand & Bissonnette, 1992) was added in the PLOC. The measure consists of 17 items, which are responded to using a seven-point Likert-type scale. The reliability and validity of the PLOC subscale-scores have been supported in previous research involving children 11 years and older (Goudas et al., 1994; Ntoumanis, 2001, 2005; Wang et al., 2009).

Procedure

Approval to conduct this study was obtained from the University's Human Research Ethics Committee. Permission to adapt the PLOC was acquired from its main author.

Prior to testing the PLOC, an expert team of four researchers with expertise in self-report assessment and motivational research, and a primary school teacher reviewed the PLOC items for clarity and conciseness. Some minor revisions were made to the items, which did not alter their content. For example, as issues with context specificity have been observed previously in children's responding to self-report questionnaires (Koskey, Karabenick, Woolley, Bonney, & Dever, 2010), the stem "I take part in physical education" was placed at the start of all items, to remind respondents of the context. Furthermore, the original seven-point Likert-type response scale was replaced by a five-point scale, as research has indicated that offering more response options decreases the reliability of children's responses due to its demands on cognitive abilities (Borgers, Hox, & Sikkel, 2004). An uneven number of

response options was preferred for pilot test purposes, as a high number of responses on the midpoint of the scale may be indicative of difficulties with the item. In further stages of the questionnaire evaluation and application the use of a four-point Likert-type scale is recommended, as these scales have been found to elicit optimal results when surveying children (Borgers et al., 2004). The verbal anchors labelling the response options in the PLOC were followed, ranging from "*strongly disagree*" (1) to "*strongly agree*" (5). Only the label of the midpoint of the scale in the PLOC, "*neutral*", was changed into "*don't know*" (3) to better represent the purpose of this response option in the pilot study.

To facilitate the question-response process pie-charts were used to visualise the response options (see Figure 1). It was anticipated that this particular format would allow minimal room for misinterpretation or selection bias, which could negatively affect the response quality (see Davis-Kean & Sandler, 2001).

Insert Figure 1 about here

To investigate whether children interpreted the items as intended, the adapted PLOC was administered using an interview-based protocol. Interviews took place on an individual basis and were audiotaped. Items were presented on a digital tablet using the Qualtrics™ online survey software. Participants were asked to read aloud the items, and were encouraged to articulate all their thoughts during the response process (think-aloud procedure).

Results & Discussion

For a measure to appropriately tap the underlying theoretical construct, it is important that items are consistently interpreted correctly. The interviews revealed that participants experienced some reading and comprehension difficulties, indicating that adaptations to the items were warranted. Revisions, which mainly involved the items' wording, were reviewed in subsequent interviews. For example, pilot tests indicated that children had difficulties understanding the term 'bothers me' in the item; "I take part in physical education because it

bothers me when I don't". This concept was consequently replaced by 'feel guilty'. The revised item explicitly taps the theoretical focus of introjected regulation as the motive to avoid feelings of guilt. Guilt has been demonstrated to develop as early as in the toddler years (Baker, Baibazarova, Ktistaki, Shelton, & van Goozen, 2012; Kochanska, Gross, Lin, & Nichols, 2002), and may, therefore, play a role in children's motivation in PE.

Pilot tests also indicated that the item "I take part in PE because I want the teacher to think I am good at it" needed to be reconsidered. Some children reported to be more concerned about the judgement of individuals other than their teacher, such as parents and peers. Responses to the item included: "I don't even like my teacher", and "I do it [PE] so I can show my mom and dad how good I am". These accounts suggest that when referring to the teacher specifically the item may not identify all children who engage in PE for introjected reasons. The items was consequently changed into; "I take part in physical education because I want others to think I am good at it".

The item "I take part in PE because it is exciting" was revised in response to reading difficulties. Children were found to struggle reading aloud 'exciting', and the item was consequently changed into "I take part in physical education because I enjoy doing it".

Two items could not be adequately revised in response to issues that emerged during the interviews, and were removed from the questionnaire. The first item "I take part in physical education because I would feel bad about myself if I didn't", tapping introjected regulation, was deleted as it was not consistently interpreted as intended based on self-determination theory. Respondents for example reported feeling bad about missing out on something fun. Secondly, the item; "I take part in physical education so the teacher won't yell at me", tapping external regulation, was excluded from the final list as interviews indicated that the item was not relevant to all children's experience. One participant stated "I have never heard our teacher yell, so that wouldn't be true for me".

All participants were capable of adequately explaining the utility of the pie-chart image, used to illustrate the response options. The image consequently remained unchanged.

At the conclusion of this qualitative study, a list of 15 items emerged, with three items tapping every behavioural regulation, the Children's Perceived Locus of Causality Scale (C-PLOC) (see Table 1). Pilot tests indicated that 8 year old participants experienced some difficulties reading the items aloud. This did not seem to impact upon their responding, but nevertheless, extra care may be required when assessing 8 year olds with the C-PLOC.

Study 2

In a subsequent quantitative study the C-PLOC was further evaluated. As the pilot tests indicated that 8 year old children may experience difficulties reading the C-PLOC items, it was focussed on 9 to 12 year old children. Confirmatory factor analyses (CFA) were performed to analyse the fit of the original five factor structure of the PLOC and a plausible alternative model to data derived with the C-PLOC. Based on the pilot test results, suggesting the relevance of all five behavioural regulations to children's motivation in PE, and previous research (Guay et al., 2010; Ryan & Connell, 1989), it was hypothesised that the five factor structure of the PLOC would be replicated for the C-PLOC.

Participants

Primary school children (N = 431) aged 9 to 12 years were recruited from 23 randomly selected co-educational public primary schools in an Australian city. Schools were located in areas representing a wide range of socio-economic status (SES), with an average SES-ranking of 3.07 (SD = 2.41)[1]. Two participants with reading difficulties were identified as outliers and removed from the sample, resulting in a final sample of 429 students (girls, n = 215, M age = 10.65 y, SD = 1.06; boys, n = 214, M age = 10.79 y, SD = 1.06).

[1] SES-ranking based on Australian Bureau of Statistics (ABS) census data from 2006. Ranges from 1 to 10, where 1 is indicative of the most advantaged 10%, and 10 of the most disadvantaged 10% governmental schools

Measures

Parent Developmental Questionnaire. The respondents' parents completed a questionnaire on family demographics and identifying any reading difficulties of their child.

Children's Perceived Locus of Causality Scale (C-PLOC). The 15-item questionnaire from Study 1 was applied to measure behavioural regulations in PE. Four-point Likert-type response scales were used. Response options ranged from "*strongly disagree*" (1) to "*strongly agree*" (4) and were visualised by a pie-chart image. Subscale scores for the five behavioural regulations were derived by averaging the corresponding item scores, whereby higher scores reflected a stronger identification with the relevant behavioural regulation.

Procedure

The study was approved by the University's Human Research Ethics Committee and the state's Department of Education. Permission to conduct the study was acquired from school principals, and parent and child consent was obtained.

The C-PLOC was part of a larger questionnaire battery, assessing children's motivation in PE. Questionnaires were administered in groups of five students at a time, during school hours, and in quiet classroom conditions. It was emphasised to participants that there were no right or wrong answers. A facilitator was present to assist with any difficulties.

Data analysis

The data were inspected for violations of normality, multicollinearity and intra-school dependencies. To test the adequacy of a five-factor structure in explaining the covariances among items of the C-PLOC, CFA was conducted using the EQS software (v. 6.2; Bentler, 1995). Each item was allowed to load only on the latent factor to which it was hypothesised to pertain. To define the metric of the latent factors, one of their factor loadings was randomly fixed to unity. The error terms associated with the indicators, the variances of the latent factors, and the correlations between the latent factors were freely estimated.

The model fit was gauged based on the λ^2 statistic, standardised root mean square residual (SRMR), comparative fit index (CFI), and root-mean square error of approximation (RMSEA). CFI values exceeding .90 are indicative of an acceptable fit (Hu & Bentler, 1999), and values below .08 and .06 suggest a well-fitting model for the SRMR and RMSEA respectively (Hu & Bentler, 1999). The CFA was repeated, testing an alternative model, and the difference in model fit was investigated with a λ^2 difference test. A bootstrap resampling analysis was conducted to confirm whether the model that was found to best describe the data could be replicated in simulated samples based on the original data. Random bootstrap samples were drawn from the overall data set, with replacement, using the EQS software. The model was re-estimated in each sample over 500 replications.

To investigate the discriminant validity of the latent factors and the presence of a simplex-like structure, inter-factor correlations were examined. Lastly, the average variance extracted (AVE) and composite reliability (Rho) index were calculated for each latent factor.

Results

Item mean scores and standard deviations are presented in Table 1. The analysis of Mahalanobis distance revealed ten outlier cases, based on a λ^2 critical value of $p < .001$ (Tabachnick & Fidell, 2001). Two participants identified as outliers had reading difficulties, and were excluded from further analyses. CFA's were conducted with and without inclusion of the remaining eight outlier cases, with almost identical results. Retaining outliers in the sample is advised in this case, as they can be a genuine representation of the population (Hair, Anderson, Tatham, & Black, 1998).

Insert table 1 about here

None of the correlation coefficients between the C-PLOC items exceeded .90, suggesting there was no problem of multicollinearity (Hair, Black, Babin, Anderson, & Tatham, 2006). Participants were recruited from different schools, and to detect possible

dependencies in the data based on school membership a linear mixed models procedure was applied using SPSS version 19. Intra class correlations (ICC) greater or equal to .10 were considered indicative of intra-group dependencies (Lee, 2000). This cut-off was not exceeded for any of the C-PLOC subscales (see Table 2), and consequently, the multivariate structure of the data was not taken into account in the model.

Insert table 2 about here

In consideration of multivariate nonnormality of the data, determined by Mardia's normalised coefficient (27.25) exceeding 5.00 (Bentler, 2005), a robust maximum likelihood estimation method was employed for the CFA. This estimation method provides a Satorra-Bentler (S-B) scaled λ^2, CFI and RMSEA (no robust SRMR). CFA results indicated that the hypothesised five factor structure did not describe the data satisfactorily, as suggested by the fit indices; S-B scaled $\lambda^2 = 301.19$, $df = 80$, $p < .001$, CFI = .88; RMSEA = .08 (90% CI = .07-.09). A high correlation was found between intrinsic motivation and identified regulation, justifying the analysis of an alternative model, in which items tapping intrinsic motivation and identified regulation were aggregated into a latent factor representing self-determined motivation. In this model items tapping introjected and external regulation were also aggregated in one latent factor, representing controlled (non-self-determined) motivation. A third factor represented amotivation. Despite the high correlation that emerged between amotivation and external regulation in the five factor model, aggregation of these behavioural regulations into the same factor was not theoretically justifiable. Amotivation represents a lack of intention to act, while all other behavioural regulations represent a form of motivation to act. The fit indices of the three factor model suggested a worse fit of the model to the data; S-B scaled $\lambda^2 = 493.10$, $df = 87$, $p < .001$, CFI = .78; RMSEA = .10 (90% CI = .10-.11), with a significant increase of the λ^2 statistic ($\Delta\lambda^2 = 191.91$, $\Delta df = 7$).

As the five-factor model resulted in a better fit, this model was further analysed. Two items were subjected to further inspection, as they presented unsatisfactory low factor loadings and remained largely unexplained by their respective factors. Firstly, modification indices for the identified regulation item "I take part in PE because it is important for me to do well at it" suggested the addition of a path between the item and the latent factor representing introjected regulation. Identified regulation is considered a self-determined form of extrinsic motivation. A relationship between the item, representing a construct characterised by relative autonomy, and a factor representing controlled motivation was not anticipated based on theory. Respondents may have interpreted 'doing well' as contingent to receiving positive ability evaluations from others, which is more controlled in character, and reflective of introjected regulation. In short, the item may not have exclusively tapped identified regulation, and its deletion seemed justifiable.

Similarly, the item "I take part in PE because I feel guilty when I don't", developed to tap introjected regulation, may not have accurately captured this behavioural regulation. Feelings of guilt can be elicited by various factors, which may not all be characteristic of introjected regulation, such as feeling guilty about missing out on an opportunity to get a good grade. Modification indices suggested the addition of a pathway between the item and the amotivation and external regulation latent factors. In contrast to the other two items of the introjected subscale, which tap the motive to approach positive competence-related outcomes, the item taps the motive to avoid negative feelings related to competence. This may explain the suggested relationship with amotivation and external regulation. In response to this issue, it was decided to focus exclusively on the approach component of introjected regulation in the C-PLOC, and the introjected regulation item was deleted from the measure.

Removal of the two items resulted in a better fitting model as suggested by the improved fit indices: S-B scaled $\lambda^2 = 156.14$, $df = 55$, $p < .001$, CFI = .94; RMSEA = .07

(90% CI = .05-.08). Standardised factor loadings for the 13-item C-PLOC are provided in Table 1. All factor loadings exceeded .50 and between 32.15% and 80.10% of the variance in the items was accounted for by their respective factors.

The five factor model was consequently re-estimated using bootstrapping, resulting in the following average fit indices; S-B $\lambda^2 = 210.02$, $df = 55$, $p < .001$, CFI = .91; RMSEA = .08 (90% CI = .07-.09). The skewness was negative for the CFI, and positive for the RMSEA. This is desirable, as it suggests stacking of the results at higher or lower values respectively (subject to the cut-off value), indicating a large number of well-fitting models. To complement this analysis in investigating the robustness of the model, and preclude possible effects of age on the results, the correlation between age and the latent factors was investigated. This correlation was significant for external, introjected and identified regulation. Despite these significant findings no multigroup CFA was performed as the effect size of such analysis would be small. However, the small correlations between age and the latent factors suggested that age did not have a large impact in the model.

Self-determination theory proposes that the pattern of correlations among the five behavioural regulations should conform to a simplex-like pattern of correlations. Regulations that are theoretically closer are expected to be more strongly and positively related compared to more distal regulations. A simplex pattern was largely supported by the data (see Table 2). Also, none of the 95% CI's of the interfactor correlations encompassed unity, supporting the discriminant validity of the factors. Discriminant validity was not consistently supported by the AVE indices, as they did not exceed the corresponding squared inter-construct correlation (SIC) for intrinsic motivation and identified regulation, nor for amotivation and external regulation (Fornell & Larcker, 1981).

Regarding reliability, a value greater than .50 is considered acceptable for the AVE index (Fornell & Larcker, 1981). This index was found to be less than satisfactory for the

amotivation, identified regulation and intrinsic motivation subscales (see Table 2). These subscales should be interpreted with care until further replication. In contrast to the AVE index, the Rho composite reliability coefficients were indicative of satisfactory reliability, with coefficients exceeding .60 (Bagozzi & Yi, 1988) for all subscales, with the exception of the identified regulation subscale, which fell just below the cut-off value (see Table 2).

Discussion

The present study reports on the development and psychometric evaluation of the C-PLOC, a measure tapping the behavioural regulations of pre-adolescent students in PE. The fit of two alternative a priori factor structures was investigated, and in line with the PLOC, a five factor structure was found to best describe the data. Bootstrap analysis confirmed the robustness of the model, and the latent factors seemed to be largely unrelated to the students' age. The reliability indices provided some evidence of coherence among the items indicating the latent factors, however, future studies are needed to draw more compelling conclusions.

Besides its latent factor structure, also the hypothesised simplex structure was largely supported for the C-PLOC, consistent with self-determination theory (Ryan & Connell, 1989), and previous results regarding the PLOC construct in the PE context (for a meta-analysis see Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003). A strong relationship was observed between intrinsic motivation and identified regulation, and discriminant validity of the two factors could not be supported. Previous studies applying the PLOC in older samples have also found high correlations between intrinsic motivation and identified regulation (e.g., Goudas et al., 1994; Lonsdale, Sabiston, Taylor, & Ntoumanis, 2011; Ntoumanis, 2001; Standage, Duda, & Ntoumanis, 2005; Wang et al., 2009), suggesting this is not a developmental issue. It has been suggested that the association between the two factors may be due to similarities in what respondents value (identified regulation) and what they find enjoyable and feel competent in (intrinsic motivation) (Eccles & Harold, 1991). This is

likely in PE, where the value of engagement is largely emphasised (e.g., for health reasons), while activities are often regarded as enjoyable by children (Dollman et al., 2005). An intrinsic motivation and an identified regulation item of the C-PLOC both refer to motivation related to learning new things. Similar to in the PLOC, these items tap enjoying to learn, and wanting to learn respectively. Children may not have been able to identify this subtle, but important difference. Inspection of the correlations between items of both subscales showed that the only inter-item correlation exceeding .50 arose between the two items tapping learning. It is likely that these two items are responsible for the lack of discriminant validity of the subscales, and future research may wish to develop two items that are more distinctive.

The strong relationship between the factors representing external regulation and amotivation that was identified in this study has not consistently been observed in previous studies applying the PLOC (e.g., Goudas et al., 1994; Ntoumanis, 2001). The high correlation may have been caused by students' low levels of external regulation and amotivation, and high levels of self-determined motivation. In samples with more diverse levels of controlled motivation, the difference between the two regulations may be more apparent.

Lastly, all C-PLOC subscales exhibited satisfactory composite reliability, with the exception of the identified regulation subscale. Conversely, most subscales displayed a less than satisfactory AVE index. Previously, issues have emerged with the internal consistency of the subscales of the PLOC, particularly for the external regulation, introjected regulation and identified regulation subscales (see Vlachopoulos, Katartzi, Kontou, Moustaka, & Goudas, 2011). For comparison purposes, the Cronbach's alpha values of the C-PLOC subscales are displayed in Table 2. Comparing these values with those found for the PLOC (see Vlachopoulos et al., 2011), it seems that the C-PLOC's introjected and external regulation subscales have an internal consistency in the high end of what has been found for

the PLOC's subscales, particularly since the introjected regulation subscale consists of only two items, and Cronbach's alpha reliability increases with scale length (Cronbach, 1951).

It has been noted that the low internal consistency that has repeatedly been observed for the introjected regulation subscale of the PLOC may be a result of the different aspects of introjected regulation tapped by its items (Lonsdale et al., 2011). Some items involve the avoidance of negative competence-related feeling, while other items are approach oriented, and concern the reinforcement of feelings of competence (see Assor, Vansteenkiste, & Kaplan, 2009; Lonsdale et al., 2011). Children have been shown to differentiate between introjected approach and avoidance regulation in academic (*M* age of participants 10.5 y) and sport settings (*M* age 15.6 y) (Assor et al., 2009). In the present study, the introjected regulation item tapping the avoidance component was deleted and the two remaining items of the subscale focus on the approach component. This seems to have resolved concerns that have been raised regarding the reliability of this subscale of the PLOC.

Limitations and future directions

The present study provides preliminary support for the validity and reliability of scores obtained with the C-PLOC when used for the assessment of 9 to 12 year old children in PE. However, a number of limitations of the present study require attention, which could inspire future research. Further studies are needed to replicate the analyses and cross-validate the factor structure of the C-PLOC, preferably in samples that include large variations in background and motivational orientations. Although schools with different SES-levels were selected, most participants were from higher SES backgrounds and had high levels of self-determined motivation. Both parents and children had to consent to participate in the study, and it is likely that children who were motivated for PE were more willing to become involved, leading to an affirmation bias. Also, even though age was found to exhibit only a small relationship with the latent factors, measurement invariance across age, but also gender

and culture needs to be confirmed for the C-PLOC. It is yet to be determined whether age trends exist in pre-adolescent children's motivation in PE settings. It has been reported that children's intrinsic motivation toward physical activity tends to decline with age (Digelidis & Papaioannou, 1999; Ntoumanis, Barkoukis, & Thøgersen-Ntoumani, 2009), but it remains to be investigated whether the same trend is observable in PE settings. The C-PLOC provides researchers with a measure to quantify pre-adolescents' motivation over primary school, and to investigate its relationship with leisure time physical activity.

Although attempts were made to keep adaptations to a minimum, pilot tests indicated that wording changes to the PLOC's items were required, as items were not consistently interpreted as intended. The adaptations limit the ability to compare results derived with the C-PLOC to those obtained with the PLOC. However, as the content of the items of both measures largely corresponds, results may be comparable if care is taken. Future studies could investigate the convergent validity of the C-PLOC and PLOC in 11 year old students, as scores obtained with both measures have been found valid in this age group.

The reliability estimates found for the C-PLOC subscales were not consistently satisfactory. Particularly in relation to identified regulation, some improvement in its measurement may be sought in further research. Future studies may also wish to develop two new items to tap introjected and identified regulation, as the subscales contain two items, while at least three indicators is preferable (Marsh, 2007).

In response to issues with the PLOC's internal consistency a revised version of the measure has recently been published, the PLOC-R (Vlachopoulos et al., 2011). This measure, which has been evaluated in students 11 years of age and over, was not consulted during the development of the C-PLOC. The syntax of the PLOC and PLOC-R items is similar, and in places identical, and thus, it is likely that, were PLOC-R to be applied to younger samples issues similar to those found for the PLOC would emerge. Nevertheless, some of the

revisions included in the PLOC-R may be considered in future research using the C-PLOC. For example, the PLOC-R could guide item revisions to resolve the lack of discriminant validity between the intrinsic motivation and integrated regulation subscales. In contrast to in the PLOC and C-PLOC, in the PLOC-R these subscales do not tap similar content, which may have resulted in the discriminant validity of its subscales (Vlachopoulos et al., 2011).

Conclusions

Results of the present study suggest that the C-PLOC is suitable for the assessment of different levels of self-determined motivation in 9 to 12 year old children in PE settings. The questionnaire displayed a sound factor structure, and an indication of satisfactory reliability was found for most of its subscales, even though some less than satisfactory outcomes suggest that reliability can be improved upon. Continued efforts are needed to test the psychometric properties of the C-PLOC, to ensure the reliability and validity of scores derived with the measure, in line with self-determination theory.

With the development of the C-PLOC it is hoped that motivational research in PE will expand its focus to children below the age of 11 years. If positive motivational orientations can be promoted in the PE context, this could have a positive effect on students' activity levels during the class, and their motivation for physical activity in leisure time.

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