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Development and Validation of Physical Activity-Specific Rumination Scale for Children Through UK Children's Voice

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ABSTRACT

Many physical activity (PA) interventions implemented to tackle the child obesity epidemic have shown limited effectiveness, possibly due to a lack of consideration of potential stress that accompanies behavior adaptation and the automatic perseverative cognition that exacerbates the stress (namely rumination). **Purpose**: The main aim of this paper is to develop and validate the PA-specific Rumination Scale for Children (PARSC) that assesses children's tendencies to engage in repeated negative thoughts about PA (Study 2). Items in the scale were derived from qualitative information about factors that inherently demotivates PA participation (intrinsic barriers) through the lived experience of UK children (Study 1). **Methods**: For Study 1, pedometry PA data were collected from 143 children (aged 6–10 years). Twenty-one focus groups were formed based on participants' year group, sex and PA level. For PARSC validation (Study 2), 382 children completed the questionnaire twice. Self-report PA, device-based PA, and avoidant coping were also assessed. **Results**: Study 1—Four overarching themes identified as intrinsic barriers were lack of competence, fear of negative experiences, external constraints and lacking a sense of purpose. Altogether, 10 higher order and lower order themes were used to construct PARSC items. Study 2—From Rasch analysis, PARSC possessed sound internal validity, internal consistency, and test–retest reliability. Self-report PA and avoidant coping were predictive of PA-specific rumination, but not device-based PA. **Conclusion**: PARSC is a useful tool to identify children ruminative about PA for whom interventions can be designed, with the intrinsic barriers considered, to promote PA behavior adaptation.

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Children; physical activity; Rasch analysis; rumination

In the past 4 decades, child obesity has become a global issue with an upward surge by more than tenfold, from 11 million in 1975 to 124 million in 2016 (NCD Risk Factor Collaboration (NCD-RisC), 2017). In the UK, about a third of children aged 2–15 are overweight or obese, and the accompanying consequence is the development of cardiovascular diseases, which are likely to be carried to adulthood if left untreated (Conolly & Davies, 2017; Llewllyn et al., 2016). Recognizing habitual physical activity (PA) to be one of the most modifiable lifestyle factors to curb the epidemic, the number of PA interventions has increased exponentially over the years, however, these initiatives have presented limited (long-term) effectiveness in increasing habitual PA or improving metabolic health status in children (Ells et al., 2018; Wang et al., 2015). A possible reason for the lack of fruitfulness is that interventions commonly target reflective (explicit) processes that assume individuals' awareness (e.g., intention and self-efficacy) instead of automatic (implicit) processes that may directly drive health behaviors (e.g., impulsivity and attention bias; Sheeran et al., 2016). Often these implicit processes are unconscious responses that hinder successful behavior adaptation but have been neglected in health behavior research (Larsen & Hollands, 2021).

For inactive children, having to move more could be stressful as it deprives them the "pleasure" of being inactive or engaging in sedentary activities, or, because it is simply unenjoyable. An implicit process that perpetuates stress response and can impede behavior adaptation is rumination. Rumination refers to the tendency to passively and repeatedly engage in negative thoughts about past, present, or future events (Nolen-Hoeksema et al., 2008). This cognitive-affective response can be elicited across situations (trait) or in certain situations/context (state; Smith & Alloy, 2009). Rumination is proposed to originate from the lack of goal attainment—a sense of unfulfillment, that "something is missing" (Martin & Tesser, 1996). Individuals with this brooding cognition tend to magnify negative affects while avoid (thoughts of) the stressors as they can cause heightened psychological and/or physiological stress reactivity (Kocsel et al., 2019; LeMoult et al., 2013; Ottaviani et al., 2016). Ruminators' tendency to suppress negative thoughts ironically increases their accessibility and makes them recurrent (Wegner, 1994). Neurophysiological evidence indicates that people who are more reactive to stress, thus less capable of coping with stress, are more likely to get stuck in this rigid cognition even when the stressors are long gone, brooding rumination is thus considered a maladaptive coping response (Brosschot, 2017; Thayer et al., 2009). Experimentally, ruminators also demonstrated poorer ability to inhibit information that is no longer relevant when they were in a negative mood, yet they were more able to ignore distractors that prevent them from reaching task goals than non-ruminators (Whitmer & Gotlib, 2013). Unsurprisingly, rumination is consistently linked to various psychological disorders such as depression and anxiety (Iqbal & Dar, 2015). Applying rumination to PA behavior, children with high

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trait rumination tendencies were notably more inactive than their low rumination counterparts, and their habitual PA level was also significantly lower than the recommended PA level (Ling et al., 2011). In adults, high ruminators were also less physically active than low ruminators, mediated by amotivation (Riley et al., 2019). Among the high ruminators, the involuntary recurrent negative thoughts about PA may have stopped them from being active. Interestingly, resonating with the goal attainment proposition about rumination, in Ling et al.'s (2011) study, high ruminators were significantly more active than the low ruminators at the initial PA measurement period, but their PA level dropped substantially after 3 weeks and stayed at the same level subsequently, reflecting their baseline habitual PA. The authors speculated that high ruminators may have been motivated to be more active as they were aware of the PA measurement; hence, they attempted to fulfil the "goal" knowing that they were physically inactive. However, as the stress from being active increasingly sapped their cognitive loads, they could not keep up with (the thought of) being active, hence the return to the PA baseline shortly after the start of the PA measurement. Thus, while ruminators have been found to cognitively avoid the (thought of the) stressors, paradoxically, they seem to also approach the stressors for a while, resonating with the goal attainment conceptualization of rumination as previously discussed (Dickson et al., 2012; Martin & Tesser, 1996).

Taken together, it appears that the relationship between rumination and negative PA behavior exists, possibly due to ruminators' tendencies to dwell on PA-related negative thoughts and/or experiences (Ling et al., 2015). However, research into the relationship between rumination and PA behavior is scarce, particularly in children, even though rumination has been linked to other negative health behaviors (Riley et al., 2019). A common limitation for the above-mentioned studies on rumination and PA behavior is that the instruments used to measure rumination tendencies were for evaluating trait rumination, and not specific to PA behavior. While trait rumination has advanced our understanding of why people engage in maladaptive health behaviors—as a means of coping with daily stress (Riley et al., 2019), context-specific state rumination can shed light on why people fail to adapt positive health behaviors. Additionally, it is evidenced that with practice, state rumination can develop into trait rumination as children's metacognition develops (Shaw et al., 2019). It is thus imperative that rumination tendencies are identified and intervened at an early age. To date, there are no validated instruments to measure rumination tendencies toward PA participation. Therefore, main aim of this investigation (Study 2) is to develop and validate the PA-specific Rumination Scale for Children (PARSC). Items for the new instrument will be generated from a focus group study (Study 1) on factors that intrinsically demotivate PA participation (intrinsic barriers), that is, reasons for the inherent dislike for PA, in UK children. We will test the internal validity, internal consistency, predictive validity, and test–retest reliability of PARSC. We expected that avoidant coping and device-based PA would be predictive of PA-specific rumination.

Study 1

Method

The aim of Study 1 is to explore the intrinsic barriers of PA through the lived experiences of school-aged children in focus group discussions. This study adopts the relativistic ontology which stipulates that subjective reality exists in every individual (Denzin & Lincoln, 2005). To ensure rigor, we considered the following—i) how to build rapport with the participants and conduct the discussions so that the data co-created provides insights into their physical and emotional experiences; ii) how to relate different experiences from diverse backgrounds; iii) how to critically reflect on the interviewers'/researchers' preconception about children's experience in both the data collection and data analysis stage (Sparkes & Smith, 2009). These considerations have been addressed in the sections below. The themes generated will inform the development and validation of the PA-specific Rumination Scale for Children (PARSC) in Study 2.

Participants

Table 1 summarizes the sample characteristics. One hundred and forty-three children aged 6 to 10 years (Year 2 to 5; M_{age} = 8.77 yrs, SD = 1.05; 50% boys) assented to participation and parental consents were received. Participants were recruited from four government-aided primary schools in the southwest of UK through the first author's introduction of the project to the pupils during school assemblies who then passed on the study information sheet to their parents/guardians to consider. Following Levitt et al.'s (2017) guidelines on upholding fidelity and utility of qualitative research, the recruited schools were from areas of different social economic status so that the data can capture diversity of experiences, in addition to the included age range and PA level, hence the results are contextualized (see Procedure below). Also, age-appropriate language was used throughout the study. All measures and procedure were approved by the Institutional Ethics Board.

Procedure

Focus group discussions were conducted in this study as children's familiarity with each other could build rapport more easily given the limited discussion time, and that their views could encourage self-reflections amongst themselves

Table 1. Descriptive statistics of the sample characteristics for Study 1 and Study 2.

		N (boys, girls)	Mean age ± sd	Mean steps ± sd
Study 1	Total sample (Sample 1)	143 (71, 72)	8.77 years ± 1.05	10,181.73 ± 2,741.10
Study 2	Total sample (Sample 2)	389 (177, 212)	8.63 years ± 1.32	—
	Sample included for internal validity, internal consistency, test-retest reliability analyses	382 (170, 212)	8.63 years ± 1.32	—
	Sample included for factors predictive of PA-specific rumination tendencies in regression analysis (a sub-sample from Study 1)	87 (45, 42)	8.94 years ± 1.02	10,106.64 ± 2,717.90

Table 2. Composition of focus group members in each year group.

	Year 2	Year 3	Year 4	Year 5
High active	1FG x 3 boys	1FG x 3 boys	1FG x 3 boys	2FGs x 3 boys
	1FG x 2 girls	1FG x 3 girls	1FG x 3 girls	2FGs x 3 girls
Low active	1FG x 3 boys	1FG x 3 boys	1FG x 3 boys	2FGs x 3 boys
	1FG x 3 girls	2FGs x 3 girls	1FG x 3 girls	2FGs x 3 girls

Note. FG = focus group. Physical activity level was objectively determined by mean daily steps in Week 3 of physical activity measurement.

(Adler et al., 2019; Levitt et al., 2017). To aid the random selection of participants for focus group discussions based on their habitual PA, all participants were given a peizo-electric pedometer (New Lifestyles 800) to wear over a nylon belt on their left hips every day during waking hours, except during water activities, for 3 consecutive weeks. The New Lifestyles 800 has presented good validity as a measurement tool for school-aged children (Ling et al., 2011). To account for potential reactivity, all pedometers were sealed and only Week 3's data were used to categorize participants into low, moderate, and high PA for each year group (Ling et al., 2011). Participants with at least 1 weekday and 1 weekend day of data in Week 3, with daily steps between 2,000 and 30,000 inclusive, were included in the analysis for Study 1 and Study 2 (Rowe et al., 2004).

Focus groups were composed based on sex, year group and high/low activity level, hence each year group consisted of at least one group of high PA boys, one group of high PA girls, one group of low PA boys and one group of low PA girls (Adler et al., 2019). Most focus group discussions lasted for 20–30 minutes and were led by the first author who has extensive experience working with this population. Some year groups had more than 2 focus groups due to insufficient time to complete the earlier sessions. Most focus groups consisted of 3 participants each, but due to absence on the date of discussions, one group only had 2 participants. Altogether 53 participants were included in 19 focus group discussions across all year groups. The two researchers responsible for data analysis considered further focus group discussions were unlikely to yield additional themes or insights into the research question; thus, no further interviews were arranged (Adler et al., 2019; Levitt et al., 2017). All focus group discussions were conducted within the respective school venues (see Table 2 for details).

Semi-structured interview questions were prepared to prompt the discussions and these questions primarily tapped into participants' daily routine and the reasons for disliking PA (Peterson-Sweeney, 2005). Open-ended questions and prompts were constantly used to ensure optimal understanding of participants' lived experiences and to steer away from the researchers' existing knowledge. Another means to enhance fidelity to the subject matter is through constant reminders amongst the researchers that participants' experiences should not be assumed during the focus group discussions nor in data analysis (Levitt et al., 2017). At the start of every focus group discussion, the concept of PA was clarified to ensure that the participants understood that all sports, exercise, play, or everyday activities (e.g., walking to school) would be considered as PA. To aid the discussions, participants were first asked to draw the activities they did not enjoy, so as to allow time to reflect on their experiences and further engage in the subsequent discussions (Morgon et al., 2002). In particular, participants were asked to reflect on the thoughts that were conjured up as they were drawing the activities that they disliked, or if they were to participate in them, as this information would serve the aim of Study 2. All focus group discussions were audio-recorded and transcribed verbatim.

Table 3. Themes identified from focus group discussions on intrinsic barriers to PA participation.

Intrinsic barriers
1. Lack of competence
2. Fear of negative experiences, including—
i) Injuries
ii) Previous negative experience
iii) Accidents
iv) Bodily discomforts
v) Uncleanliness
3. External constraints, including—
i) Time
ii) Sex stereotype
iii) Unfair play
4. Lack of a sense of purpose

Focus group analysis

Two researchers conducted thematic analysis using QSR NVIVO version 12 software. Specifically, thematic analysis akin to Braun and Clarke (2019, 2021) coding reliability approach was adopted as themes were generated through participants' explicit mentioning of the intrinsic barriers to PA, rather than through the more open interpretative approach to data analysis. The coding reliability approach was considered more appropriate given the study aim and the limited time allocated to each focus group. The researchers first familiarized themselves with the transcripts, then a deductive approach was initially employed, followed by an inductive approach, as recommended for analyses that are partially addressing existing theories (Elo & Kyngäs, 2008). The researchers first coded and organized the data into higher order and lower order themes independently in order to ensure fidelity to the research topic (Levitt et al., 2017). Following the relativist approach, the researchers acted as critical friends in order to encourage reflections and challenge the interpretations of how the data was understood so as for a coherent story of the participants' lived experiences to emerge (Levitt et al., 2017; Smith & McGannon, 2018). Data analysis concluded when both researchers had reached saturation in the analysis and that the final coding scheme could sufficiently addressed the study aim.

Results

Four themes emerged as central to why children were disengaged from PA. These are concerned with a lack of competence, fear of negative experiences, external constraints, and a lack of purpose (Table 3).

Lack of competence

When children failed to experience a sense of accomplishments in certain activities, they tended to stop engaging. Many attributed the lack of competence to their ability, and some had linked it to their natural built (e.g., in playing basketball).

Varying degrees of resilience toward the lack of competence were demonstrated, whereby some would persist but some would stop trying after a few attempts.

I can't learn (to play football) because I never go to sports club, [. . .] 3 times I don't catch it then I quit. [Low active boy, Year 3]

Confidence might be further dampened when children attributed social exclusion in PA participation to their lack of competence, and this might lead to further avoidance of participation.

I never get to jump over the rope, and everyone called me that I need to hold [the rope] and wrap it round for people to go on it. [High active girl, Year 2]

Nobody let me be a goalie, but sometimes well I'm terrified at goalie. [High active boy, Year 2]

Fear of negative experiences

Resonating the avoidance tendency was the prominent theme of fear across all focus groups. Children could be fearful of getting hurt and experiencing accidents during PA.

[I don't want to do gymnastics] because you can hurt yourself because I saw it this one year in the Olympics. This guy banged his leg on this thing and it just like broke. And [I don't like] tennis because if you whack too hard you can sprain your wrist or something. [High active girl, Year 5]

I don't like [swimming] because I always think when you swim you might drown. [Low active boy, Year 3]

The above examples suggest that some children were not only fearful about experiencing negative incidents again, but also accidents that had not happened to them before. Another bodily experience that some children tried to avoid was bodily discomfort such as "stitches" and "headaches." Interestingly, some children considered being "out of breath" as negative which was associated with being "tired," hence aerobic activities such as running and swimming were undesirable. Lastly, younger children and older girls tended to be weary about "getting dirty" during PA which also had influence over their choice of activities. Worth noting also is that only one girl mentioned about being "sweaty" was a reason for not engaging in PA.

External constraints

Some external factors were less frequently mentioned but nonetheless appeared to play a role in children's PA participation. One of them was time constraints due to schoolwork commitments. A minority of children had expressed that they would have liked to engage in more PA if they did not have schoolwork. Furthermore, primarily younger children, disliked activities that either were sex-stereotyped or involved the other sex who behaved differently.

[I don't like football] because boys don't really like girls and girls don't really like boys and there will be a mess and will shout at each other, and I don't like that.

[Low active girl, Year 2]

[I don't dance because] it makes you feel like a girl. [Low active boy, Year 3]

Even though mainly girls expressed their disapproval of boys' behavior during activities, it was also a case of unfair play that deterred engagement, such as previous experiences of "rough" play or intentional "pushing."

Lack of purpose

The final theme that appeared to be an intrinsic barrier to PA engagement for some children is a sense of "what's the point?" It was neither liking nor disliking, but perhaps this sentiment came from a dissociation between the activities and the identified facilitators.

Because you just kick a ball and that's it, what's the whole point about football? [High active boy, Year 3]

I always think that you're just running around to kick the ball and score a goal (and that's it!) [Low active girl, Year 5]

To sum up, four higher order themes have been identified as intrinsic barriers of PA and lower order themes have been classified under two of them (see Table 3 for details). In total, 10 themes (higher order and lower order) have been used to construct the PA-specific Rumination Scale for Children (PARSC) in Study 2.

Study 2

Study 2 aims to develop the PA-specific Rumination Scale for Children (PARSC) using a modern psychometric approach to determine the internal validity and internal consistency of the scale. Additionally, test–retest reliability and factors predictive of PA-specific rumination tendencies, namely avoidance coping, device-based PA, and self-report PA, will be assessed.

PARSC will be assessed using an analytic approach based on Rasch Measurement Theory. This approach provides a basis for investigating a number of psychometric properties of multi-item instruments, and its use has been gaining momentum due to its additional advantages over Classical Test Theory-based approaches. The Rasch model is a probabilistic model that places persons and items at locations along the same underlying latent continuum (of rumination, in this case; Rasch, 1960). The likelihood of a person's response to an item is simply a product of the difference in location between the person and the item. The Rasch analytic approach allows multiple properties of a psychometric scale to be assessed within the same framework. All individual items are assessed in terms of whether they contribute to the underlying trait, whether response categories are appropriate and working as intended, whether they are statistically dependent with other items in the scale, and whether there is any apparent bias between specific response groups. Additionally, when Rasch modeling assumptions are satisfied, the ordinal scale scores can be transformed to a continuous scale for conceptually sound utilization in research (Wilson, 2005).

Method

Participants

Three hundred and eighty-nine children aged 6 to 11 years (Grades 1 to 6) were recruited from 5 local primary schools in the UK—4 from the southwest region (Sample 1 from Study 1; n = 143) and 1 from the northeast region (Sample 2; n = 246; 45.5% boys; mean age = 8.63 years ± 1.32). Seven participants failed to complete PARSC at both the test and retest time points, hence only 382 cases were included in the analyses

(see Table 1). All participants provided written assent and their parents provided written consent. All measures and procedure were approved by the Institutional Ethics Board.

Procedure

On a normal school day at their respective schools, all participants completed the PARSC and the PA subscale from the Physical Self-Description Questionnaire—Short version (PSDQ-S; Marsh et al., 2010). Participants completed PARSC twice with 1–2 weeks apart for test–retest reliability. Sample 1 also completed the avoidant coping subscales from the Children's Coping Strategies Checklist (CCSC; Ayers et al., 1996) and wore a peizo-electric pedometer (New Lifestyles 800; see details from Study 1). For the questionnaires, a researcher read out every question and encouraged participants to ask for clarifications where necessary.

Measures

Physical Activity-specific Rumination Scale for Children (PARSC). Out of all the themes identified as the intrinsic barriers of PA from Study 1, 10 have been concurred by the researchers as potential thoughts that may hinder PA participation in young children (Table 3). Each theme was then formulated into a question that reflect the tendencies to engage in that negative thought, e.g., "How often do you think you're bad at it?" and "How often do you think you might get hurt?" All questions are anchored by an introduction specifying that each question conveys an unpleasant thought that one might have before engaging, while engaging or after engaging in PA (abiding by the definition of rumination). The meaning and examples of PA were also provided. The response scale for each item includes 1 (never), 2 (sometimes), 3 (often), to 4 (all of the time). The number of response choice is deemed appropriate for this age group who may find more choices to be conceptually challenging to distinguish. Additionally, excluding the midpoint could eliminate the ambiguity of the midpoint choice, as it could be interpreted either as neutral or "I don't know" regardless of the choice description (Streiner & Norman, 2008; Weng, 2004). Wordings of all items and response choices were reviewed by two experienced primary school educators to check for understanding for the target population. Some modifications have been made, e.g., "How often do you think that people may play unfairly?" (item 10) was changed from "How often do you think people will not play by the rule?" as the word "fair" is more commonly used by children than "play by the rule."

As a pilot test to further ascertain the face and content validity, two children from each year group were invited to complete PARSC in the presence of a researcher. They were asked to complete the questionnaire by themselves and were encouraged to ask for clarifications. On completion, the researcher asked each child to explain their answers to a few items to ascertain their understanding. Three children expressed that they were occasionally undecided about the response choices, nonetheless, as Rasch analysis will inform the appropriateness of the response scale, no modifications had been made at this stage. As all 10 children appeared to sufficiently comprehend the questionnaire, their data were included in the final analyses. It is worth mentioning that where possible, it would be preferable to read out each item especially to those younger than 8 years of age. This could further aid understanding and completion of the scale.

Physical Self-Descriptive Questionnaire—short version (PSDQ-S; Marsh et al., 2010). PSDQ-S measures various aspects self-perceived physical attributes, such as sporting skills and health. For the purpose of the current study, only the Physical Activity Subscale (four items, e.g., "I do lots of sports, dance, gym, or other physical activities"), which measures self-perceived level of PA, was used. The response scale ranges from 1 (True) to 6 (False), with no descriptors for the in-between options. The PSDQ-S has consistently demonstrated sound psychometrics to be used in school-aged children (Rudd et al., 2017).

Children Coping Strategies Checklist (CCSC; Ayers et al., 1996). The CCSC was designed to measure coping strategies adopted by children and adolescents. It is a 52-item self-report inventory, but for validation purpose, only three subscales—repression, wishful thinking and avoidant actions—collectively indicative of the avoidant coping construct were used. Example items are "You tried to ignore it," "You wished that things were better," and "You avoided the people or activities that made you feel bad," respectively. Each subscale consists of four items rated on a 4-point Likert scale—1 (never), 2 (sometimes), 3 (often), and 4 (most of the time). The CCSC has demonstrated good internal validity and consistency among school-aged children (Ayers & Sandler, n.d.; Simpson et al., 2018).

Analysis strategy

The internal construct validity and psychometric properties of the PARSC were assessed using Rasch analysis with the RUMM 2030 software, utilizing a partial-credit model (Andrich et al., 2009). The analysis process was conducted systematically to determine the extent to which the PARSC item set satisfies Rasch model assumptions, and to identify whether any misfit is present. Satisfactory *overall fit* would be indicated by a non-significant Chi-square probability (at $p = .05$). *Individual item fit* and *individual person fit* would be determined by fit residual values between ±2.5, and a non-significant Bonferroni-adjusted Chi-square probability (at $p = .05$; Ramp et al., 2009; Shea et al., 2009). Additionally, we assessed if the items measure the same underlying construct (*unidimensionality*) as indicated by a series of t-tests determining whether separate subsets of items deliver different person estimates in <5% of cases (with 95% confidence intervals applied; Tennant & Conaghan, 2007). To ascertain whether the response to any item had a direct impact on the response to any other item (*local independence*), we inspected if any between-item residual correlation matrix (Q3) values >0.2 of the matrix average (Christensen et al., 2017; Marais & Andrich, 2008). Response category functioning was assessed through inspection of the threshold map and the category characteristic curves, and the relative person and item location distributions (targeting) were assessed with the person-item threshold map (Pallant et al., 2006). Further, a *differential item functioning (DIF)* test was undertaken to confirm whether responses to any items displayed bias between groups—sex and age groups in our case. This is assessed with the analysis of variance DIF test available

in RUMM, where DIF is indicated at p = .05 (Bonferroni-adjusted). In this instance, if DIF was identified for multiple items in opposing directions, the DIF items would be grouped into a subtest to explore if DIF would be canceled out at test level (Andrich & Hagquist, 2015). Additionally, the internal consistency of PARSC was assessed by the person separation index (PSI), which can be interpreted in a similar way to a Cronbach's α value. That is, .60 −.69—acceptable, .70 −.79 —sound, .80 −.89 -good and .90 or above—excellent; Stevens, 2002).

SPSS for Windows 22 was used to generate descriptive statistics for the cohort and to ascertain the test–retest reliability of PARSC and factors predictive of PA-specific rumination tendencies. The revised scoring of PARSC would be used if Rasch analysis indicated rescaling was called for. The data were first checked for univariate and multivariate normality and outliers. Test–retest reliability was assessed by intraclass correlation with 95% CI using a two-way random model (intraclass correlation coefficient (ICC) ≥.81 = excellent, .61–.80 = good, .41–.60 = moderate and ≤ .40 = poor; Nunnally & Bernstein, 1994). Multiple regression was performed to evaluate the association between PA-specific rumination tendencies (dependent variable) and device-based PA level, self-report PA level and avoidant coping (independent variables). In total, 87 cases out of Sample 1 were included in the regression analysis as they fulfilled the inclusion criteria for device-based PA measurement (see Procedure under Study 1 for device-based PA measurement inclusion criteria, and Table 1 for sample characteristics).[1]

Results

Internal validity and internal consistency using Rasch analysis

Original scale

For the original PARSC analysis, six well-distributed class intervals were utilized (n = 50–77). Adequate overall fit of PARSC to the Rasch model is demonstrated from the non-significant Chi-square probability value (χ^2 (50) = 58.41, p = .19). Fit residual values for all items were within ±2.5, suggesting good item fit. A single person was identified with fit residual >2.5 (indicting an unexpected response pattern), and 24 people were identified with fit residual < −2.5 (indicating a predictable response pattern). These people were retained within the analysis, as they were not considered to be overly corrupting the analysis.

One pair of items, items 2 (How often do you think you might get hurt?) and 8 (How often do you think serious accidents may happen?), demonstrated local dependency with a residual correlation of 0.12, >0.2 compared to the mean of all residual correlations. As the item set has no preexisting clustering, the comparative groups for the unidimensionality series of t-tests was determined through the positively loading and negatively loading items from a principal component analysis of the residuals. The series of t-tests reported that 3.93% of cases demonstrated significant differences between the two comparative person estimates that were generated. This suggests unidimensionality of the scale. Furthermore, DIF analyses suggest that four items display DIF-by-sex, and three items display DIF-by-age group (Bonferroni adjusted p-value >0.05).

The person-item threshold distribution suggests that distribution of the person estimates and item threshold was reasonably matched (or targeted; mean ± sd person logit = −.59 ± .89, with average-scale item mean = 0.00 logit), that is, item difficulty could adequately address the range of rumination tendencies (Figure 1(a)). Regarding the response categories, disordered thresholds were evident for all items except item 4 (How often are you think you might feel "funny" in your body, like in the tummy, in the arms and legs, or feel "tired"?), indicating that the response scale is not working in the expected manner for most items. Figure 2(a) illustrates the category probability curve for item 6 as an example. This suggests that 4-response option appears too many to be operational within this sample. Inspection of the person-item map indicates that categories 2 and 3 ("sometimes" and "often") appeared to be the most difficult to endorse. Based on this information, a generic recode was applied across all items, where categories 2 and 3 ("sometimes" and "often") were treated as an equivalent response, to deliver an implied 3-response category format.

Revised scale after rescoring

After rescoring, the class interval distribution was reviewed. Due to the uneven distribution from 42 to 126 across the 6 intervals, we chose a 5-class interval structure in order to reduce the variability between each class (57–94) before proceeding with model fit analyses. The revised scale demonstrated good overall fit to the Rasch model (χ2 (40) = 52.36, p = .09). All individual items satisfied the model fit criteria. One participant displayed a fit residual >2.5 (2.61), and 30 participants displayed fit residuals < −2.5. No local dependency was evident from the residual correlation matrix, and the scale displayed (series of t-tests = 4.71%).

Rescoring of the response scale also saw more evenly distributed thresholds (Figure 2(b)) and the person-item threshold map depicts adequate targeting between item difficulty and person attributes (Figure 1(b)). DIF was still present for sex (items 1, 6 and 7—Uniform DIF) and age group (items 1 and 5 —Uniform DIF). A subtest was conducted for each person factor including the identified items, and analyses of variance indicated that the DIF items canceled each other out at test level (p = .07 and p = .11 respectively); hence, no further actions were taken to address the DIF issue. Lastly, internal consistency of PARSC was deemed satisfactory with PSI = .73.

Test re-test reliability and predictive validity

Utilizing the logit (interval) scores of the revised PARSC from Sample 1 and Sample 2, ICC coefficient suggested that the revised PARSC possessed sound test–retest reliability (ICC = .77; 95% CI, .72—.81). For predictive validity, avoidant coping, device-based, and self-report PA level were entered as

[1]Sample 2 did not complete the Children Coping Strategies Checklist nor PA measurements, they were thus excluded in the regression analysis (see Procedure under Study 2).

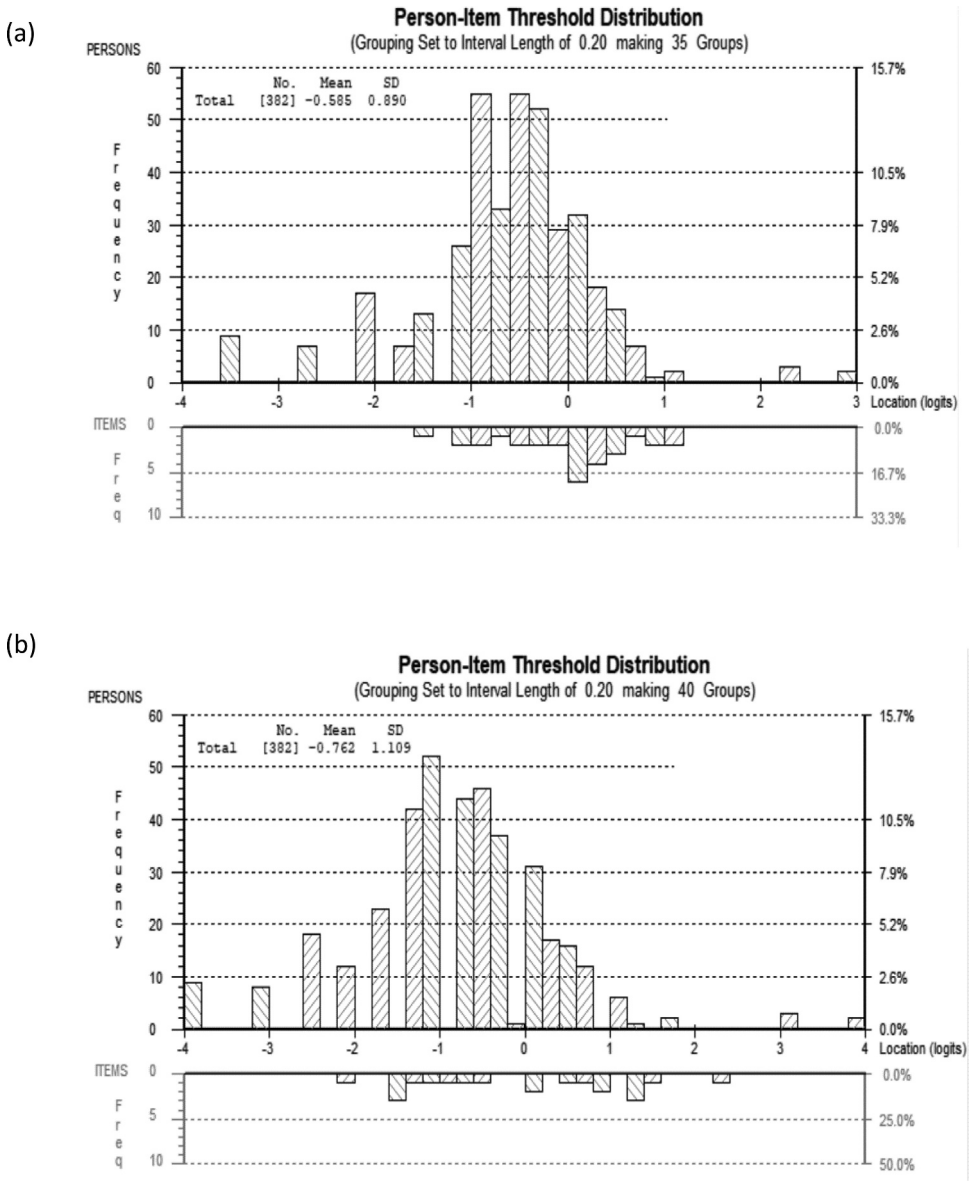

Figure 1. The person-item threshold distribution map illustrates the extent to which participants' PA-specific ruminative tendencies (top) matches item contribution to the construct (bottom). The logits (location) scale on the x-axes represent a standardized score where the mean rumination score and mean item contribution is set to 0, and one logit = one SD. The y-axis of the top histogram shows the distribution of standardized scores while the y-axis of the lower histogram shows the probability of endorsing a given score for a particular item. Map (a) displays targeting between item difficulty and person attributes of the original scale and map (b) depicts that of revised scale after rescoring.

predictors. Results suggest that PA rumination tendencies are predicted by self-report PA ($\beta = .16$, $p = .003$; 95% CI, .04—.25) and avoidant behavior ($\beta = .10$, $p = .02$; 95% CI, .02—.19), but not device-based PA ($\beta = -8.31E$, $p = .36$), and 16% of the variance can be explained by the model ($F(3, 83) = 5.00$, $p = .003$).

Discussion

In recent years, there is growing emphasis on the automatic implicit processes that drive health behavior over and above the explicit processes that assume conscious awareness, as automatic neurophysio-cognitive-affective responses can directly drive our health decisions within split seconds (Sheeran et al., 2016, 2017). Oversight of the former might be a key reason for the moderate effectiveness of PA behavior interventions (Larsen & Hollands, 2021). Essentially, rumination is a cognitive coping mechanism that is closely linked to implicit cognition such as attention bias and affective processes (Thayer et al., 2009). While rumination has shown to be a potential self-regulatory mechanism that governs PA behavior, our understanding of this coping style in its application to health behaviors is still in its infancy (Ottaviani et al., 2016; Schlinkert & Koole, 2018). This is partly attributable to a lack of a psychometric instrument to measure PA-specific rumination. Our study is the first to develop and validate a rumination scale specific to PA behavior for school-aged UK children. PARSC with a 3-point response scale has demonstrated sound internal validity, internal consistency, and test–retest reliability. PA-specific rumination tendencies were also found to be negatively associated with self-report PA and positively linked to avoidant coping. Both findings are as expected—ruminators have the tendency to avoid stressors as

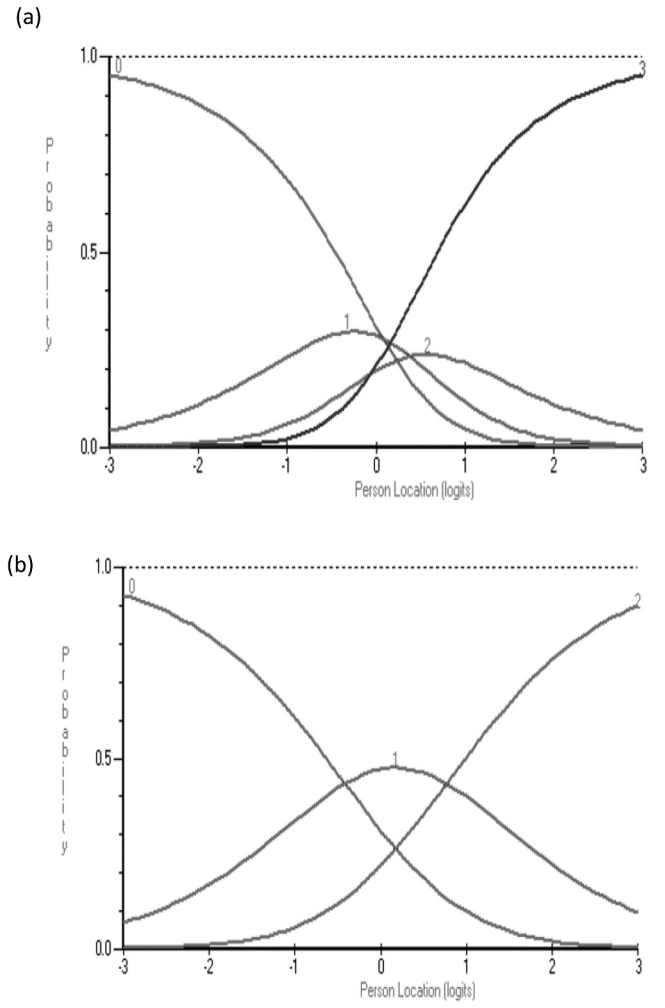

Figure 2. Category probability curve of item 6 (a) from the original scale and (b) after rescoring.

it could temper their heightened stress reactivity (Dickson et al., 2012; Nolen-Hoeksema & Harrell, 2002), and the former finding resonates with existing literature (Riley et al., 2019). However, it is surprising that device-based PA is not linked to rumination tendencies. It is possible that the shrunken sample size in the analysis, due largely to attrition/noncompliance from PA measurement (40%), failed to capture the extreme ends of the PA spectrum while the possible underestimation of light-moderate PA and overestimation of moderate-vigorous PA from the self-report might have artificially inflated the variability (Sprengeler et al., 2017). This level of attrition/noncompliance is surprisingly larger than a previous report on similar measurement issues in youth interventions (approximately 12% for attrition rate and 26% for noncompliance rate; Howie & Straker, 2016). The smaller sample size has also underpowered the predictive validity analysis by about 10%, based on β error probability of 5%, through a posthoc power analysis. Future studies should consider measuring device-based PA in a larger sample to ascertain the predictive validity of PARSC. Nonetheless, PARSC can be used to further our understanding of the role of rumination in children's PA behavior. Future research can examine how PA-specific rumination might link to other implicit processes such as attention bias and inhibitory control from a neurocognitive perspective in order to provide a comprehensive understanding of the neurophysiological-cognitive-affective self-regulatory mechanisms that underpin PA behavior adaptation (Thayer et al., 2009).

As PARSC was developed through accounts of the lived experience of children from the UK, it can be considered as a culture-specific instrument. Nonetheless, it can potentially be used for other child populations. Findings from previous qualitative studies on barriers of PA with Hispanic and Australian children are largely similar to the themes identified in the current study, however, additional prominent themes from the former include concerns about getting "sweaty," and parent-driven rules such as expectations of behavior indoor, and neither studies identified uncleanliness, sex stereotype, and lack of a sense of purpose from their participants (Ross & Francis, 2016; Stanley et al., 2013). These discrepancies could potentially stem from cultural differences, and from the fact that focus of these studies is less on the intrinsic barriers but on environmental barriers as well. Therefore, if PARSC is used in children from different cultural backgrounds, it is recommended that further validation process is in place to ascertain its suitability.

For some of the intrinsic barriers that are relatively uncontrollable by individuals, such as sex stereotype, uncleanliness, unfair play, previous negative experiences and to some extent, injuries and accidents, it is important for researchers and education professionals to help children overcome them by building resilience in order to minimize their influence on children's PA. PA interventions can also consider implementing strategies that address the other barriers through effective coaching. For example, understanding that some children find the "out of breath" experiences disconcerting, PE sessions can focus on pacing strategies for a more even distribution of effort intensity so that prolonged PA can be enjoyable, and at the same time, awareness about this sensation can be raised as part of normal physiological functioning so that children can reappraise the experience (Edwards & Polman, 2013). Psychological interventions that aim to reduce stress response to PA, such as mindfulness training, can also be implemented in order to promote PA adaptation (Brown & Ryan, 2003). Intriguingly, when children expressed that a lack of purpose being a barrier, they did not consider staying healthy as a purpose, yet, all agreed that PA is a means to lead a healthy lifestyle. This certainly has implications on the content of health messaging in PA interventions and public health campaigns, as focus on health promotion is perhaps ineffective in motivating children to be active due to its lack of relevance to children's value (Kreuter & Wray, 2003). Future research can also explore the intrinsic motivators of PA, as incorporating these factors in public health messages and PA interventions might enhance effectiveness in these initiatives.

A few limitations of the current study are worth noting. First, due to the limited linguistic repertoire and self-reflexive ability, drawing in-depth information from the youngest age group in focus group discussions was challenging. Focus group discussions might not be the best way to understand the lived experience of children under 7 years of age, instead, we might have to rely on reports from parents and teachers who can explore children's in-the-moment PA experiences. Alternatively, more creative approaches can be adopted, such as role play and using

playdoh, if time allows (Adler et al., 2019). Additionally, one group only consisted of two members that might have limited potential discussions. Moreover, the psychometric assessment led to a post-hoc rescaling of PARSC, and some DIF was indicated for both sex and age groups. Although the post-hoc scoring appeared to work favorably, and the impact of the DIF appeared to be small at the test level, this should be further tested by a different sample in order to confirm the psychometric properties of the PARSC, and to determine whether a three-response category format is appropriate when tested prospectively. Nonetheless, we consider the themes identified from the focus group discussions and the phrasing of the items indicative of the construct in question, future studies can lend support of construct validity through psychophysiological response to PA-related stimuli with children of extreme ends of the PA spectrum. Lastly, data of participants with physical/intellectual disabilities, or those who were physically injured during the PA measurement period, have been excluded from analysis as their habitual PA level and/or understanding of the questionnaire items might be affected. Future studies should consider the inclusion of the data for analysis in order to promote inclusivity.

Conclusion

To conclude, the current study has provided an in-depth understanding of the culture-specific intrinsic barriers of PA in UK children which has contributed to the development of PARSC. The psychometric properties of PARSC were also confirmed. Through PARSC, we can advance our understanding of rumination as a self-regulatory coping mechanism that underpins PA behavior adaptation in young children. It is also imperative that state rumination tendencies are identified at an early age, due to its potential to develop into a trait-like cognition which can adversely affect mental health. Moreover, we encourage researchers and public health professionals to consider our qualitative findings in the design of future PA interventions and health messaging for this population. Additionally, education professionals can implement interventions such as resilience training and mindfulness training to effectively promote PA to young children with relatively high PA rumination tendencies as identified through PARSC.

What does this article add?

Physical activity interventions for children have demonstrated limited effectiveness to promote physical activity, possibly because automatic implicit processes that may directly hinder behavior adaptation have been largely overlooked. The mechanistic process of interest in this study is physical activity-specific rumination, defined as the tendency to engage in repetitive negative thoughts about physical activity. To date, we have limited understanding of the link between rumination and physical activity behavior in children, despite that rumination has been studied in other health behaviors. In this study, we have developed the Physical Activity-specific Rumination Scale for Children (PARSC) through exploring factors that intrinsically demotivate (intrinsic barriers) school-aged UK children from engaging in physical activity. PARSC has demonstrated sound psychometric properties. This is the first study to develop and test an instrument that measures physical activity-specific rumination tendencies, and to provide intrinsic barriers that are culturally relevant. Not only will the questionnaire further our understanding of the role of rumination in children's physical activity behavior, crucially, it can be used to identify children with physical activity rumination tendencies and implement interventions to promote long-term physical activity participation and mental health.

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Author contributions

The study was conceived by FCML who also collected and analyzed data for both studies. JS co-analyzed the qualitative data and MH co-analyzed the quantitative data. All authors contributed to manuscript preparation.

Data availability statement

Quantitative data of the study is available at https://osf.io/3vte5/.

Disclosure statement

The authors declare no conflicts of interest.

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References

Adler, K., Salanterä, S., & Zumstein-Shaha, M. (2019). Focus group interviews in child, youth, and parent research: An integrative literature review. *International Journal of Qualitative Methods*, *18*. https://doi.org/10.1177/1609406919887274

Andrich, D., & Hagquist, C. (2015). Real and artificial differential item functioning in polytomous items. *Educational and Psychological Measurement*, *75*(2), 185–207. http://doi.org/10.1177/0013164414534258

Andrich, D., Sheridan, B., & Luo, G. (2009). *RUMM 2030*. RUMM Laboratory.

Ayers, T. A., & Sandler, I. N. (n.d.). *Manual for the children's coping strategies checklist and the how I coped under pressure scale*. Arizona State University. http://www.asu.edu/clas/asuprc

Ayers, T. S., Sandler, I. N., West, S. G., & Roosa, M. W. (1996). A dispositional and situation assessment of children's coping: Testing alternative models of coping. *Journal of Personality*, *64*(4), 923–958. http://doi.org/10.1111/j.1467-6494.1996.tb00949.x

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, *11*(4), 589–597. https://doi.org/10.1080/2159676X.2019.1628806

Braun, V., & Clarke, V. (2021). To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. *Qualitative Research in Sport, Exercise and Health*, *13*(2), 201–216. https://doi.org/10.1080/2159676X.2019.1704846

Brosschot, J. F. (2017). Ever at the ready for events that never happen. *European Journal of Psychotraumatology*, *8*(1), 1309934. https://doi.org/10.1080/20008198.2017.1309934

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*(4), 822–848. http://doi.org/10.1037/0022-3514.84.4.822

Christensen, K. B., Makransky, G., & Horton, M. (2017). Critical values for Yen's Q3: Identification of local dependence in the Rasch model using residual correlations. *Applied Psychological Measurement*, *41*(3), 178–194. http://doi.org/10.1177/0146621616677520

Conolly, A., & Davies, B. (2017) *Health survey for England 2017*. NHS Digital. https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2017

Denzin, N. K., & Lincoln, Y. S. (2005). Introduction: The discipline and practice of qualitative research. In N. Denzin & Y. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed., pp. 1–32). Sage.

Dickson, K. S., Ciesla, J. A., & Reilly, L. C. (2012). Rumination, worry, cognitive avoidance, and behavioral avoidance: Examination of temporal effects. *Behavior Therapy*, *43*(3), 629–640. http://doi.org/10.1016/j.beth.2011.11.002

Edwards, A., & Polman, R. (2013). Pacing and awareness: Brain regulation of physical activity. *Sports Medicine*, *43*(11), 1057–1064. http://doi.org/10.1007/s40279-013-0091-4

Ells, L. J., Rees, K., Brown, T., Mead, E., Al-Khudairy, L., Azevedo, L., McGeechan, G. J., Baur, L., Loveman, E., Clements, H., Rayco-Solon, P., Farpour-Lambert, N., & Demaio, A. (2018). Interventions for treating children and adolescents with overweight and obesity: An overview of Cochrane reviews. *International Journal of Obesity*, *42*(11), 1823–1833. http://doi.org/10.1038/s41366-018-0230-y

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115. http://doi.org/10.1111/j.1365-2648.2007.04569.x

Howie, E. K., & Straker, L. M. (2016). Rates of attrition, non-compliance and missingness in randomized controlled trials of child physical activity interventions using accelerometers: A brief methodological review. *Journal of Science and Medicine in Sport*, *19*(10), 830–836. http://doi.org/10.1016/j.jsams.2015.12.520

Iqbal, N., & Dar, K. A. (2015). Negative affectivity, depression, and anxiety: Does rumination mediate the links? *Journal of Affective Disorder*, *181*, 18–23. http://doi.org/10.1016/j.jad.2015.04.002

Kocsel, N., Köteles, F., Szemenyei, E., Szabó, E., Galambos, A., & Kökönyei, G. (2019). The association between perseverative cognition and resting heart rate variability: A focus on state ruminative thoughts. *Biological Psychology*, *145*, 124–133. https://doi.org/10.1016/j.biopsycho.2019.04.004

Kreuter, M. W., & Wray, R. J. (2003). Tailored and targeted health communication: Strategies for enhancing information relevance. *American Journal of Health Behavior*, *27*(Supp 3), S227–232. http://doi.org/10.5993/ajhb.27.1.s3.6

Larsen, J. K., & Hollands, G. J. (2021). Targeting automatic processes to reduce unhealthy behaviours: A process framework. *Health Psychology Review*. Advance online publication. https://doi.org/10.1080/17437199.2021.1876572

LeMoult, J., Arditte, K. A., D'Avanzato, C., & Joormann, J. (2013). State rumination: Associations with emotional stress reactivity and attention biases. *Journal of Experimental Psychopathology*, *4*(5), 471–484. http://doi.org/10.5127/jep.029112

Levitt, H. M., Motulsky, S. L., Wertz, F. J., Morrow, S. L., & Ponterotto, J. G. (2017). Recommendations for designing and reviewing qualitative research in psychology: Promoting methodological integrity. *Qualitative Psychology*, *4*(1), 2–22. https://doi.org/10.1037/qup0000082

Ling, F. C. M., Masters, R., & McManus, A. M. (2011). Rehearsal and pedometer reactivity in children. *Journal of Clinical Psychology*, *67*(3), 261–266. http://doi.org/10.1002/jclp.20745

Ling, F. C. M., McManus, A. M., Knowles, G., Masters, R. S. W., & Polman, R. C. J. (2015). Do children emotionally rehearse about their body image? *Journal of Health Psychology*, *20*(9), 1133–1141. http://doi.org/10.1177/1359105313507965

Llewllyn, A., Simmonds, M., Owen, C. G., & Woolacott, N. (2016). Childhood obesity as a predictor of morbidity in adulthood: A systematic review and meta-analysis. *Obesity Review*, *17*(1), 56–67. http://doi.org/10.1111/obr.12316

Marais, I., & Andrich, D. (2008). Formalizing dimension and response violations of local independence in the Unidimensional Rasch model. *Journal of Applied Measurement*, *9*(3), 200–215.

Marsh, H. W., Martin, A. J., & Jackson, S. (2010). Introducing a short version of the physical self-description questionnaire: New strategies, short-form evaluative criteria, and applications of factor analyses. *Journal of Sport & Exercise Psychology*, *32*(4), 438–482. http://doi.org/10.1123/jsep.32.4.438

Martin, L. L., & Tesser, A. (1996). *Ruminative thoughts – Advances in social cognition*. LEA.

Morgan, M., Gibbs, S., Maxwell, K., & Britten, N. (2002). Hearing children's voices: methodological issues in conducting focus groups with children aged 7–11 years. *Qualitative Research*, *2*(1), 5–20. https://doi.org/10.1177/1468794102002001636

NCD Risk Factor Collaboration (NCD-RisC). (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: A pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. *Lancet*, *390*(10113), 2627–2642. http://doi.org/10.1016/S0140-6736(17)32129-3

Nolen-Hoeksema, S., & Harrell, Z. (2002). Rumination, depression and alcohol use: Tests of gender differences. *Journal of Cognitive Psychotherapy*, *16*(4), 391–404. http://doi.org/10.1891/jcop.16.4.391.52526

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, *3*(5), 400–424. https://doi.org/10.1111/j.1745-6924.2008.00088.x

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.

Ottaviani, C., Thayer, J. F., Verkuil, B., Lonigro, A., Medea, B., Couyoumdjian, A., & Brosschot, J. F. (2016). Physiological concomitants of perseverative cognition: A systematic review and meta-analysis. *Psychological Bulletin*, *142*(3), 231–259. http://doi.org/10.1037/bul0000036

Pallant, J. F., Miller, R. L., & Tennant, A. (2006). Evaluation of the Edinburgh post natal depression scale using Rasch analysis. *BMC Psychiatry*, *6*(1), 28. http://doi.org/10.1186/1471-244X-6-28

Peterson-Sweeney, K. (2005). The use of focus groups in pediatric and adolescent research. *Journal of Pediatric Health Care*, *19*(2), 104–110. http://doi.org/10.1016/j.pedhc.2004.08.006

Ramp, M., Khan, F., Misajon, R. A., & Pallant, J. F. (2009). Rasch analysis of the multiple sclerosis impact scale (MSIS-29). *Health and Quality of Life Outcomes*, *7*(1), 58. http://doi.org/10.1186/1477-7525-7-58

Rasch, G. (1960). *Probabilistic models for some intelligence and attainment tests*. Danmarks Paedagogiske Institute.

Riley, K. E., Park, C. L., & Laurenceau, J. P. (2019). A daily diary study of rumination and health behaviors: Modeling moderators and mediators. *Annals of Behavioral Medicine*, *53*(8), 743–755. http://doi.org/10.1093/abm/kay081

Ross, S. E. T., & Francis, L. A. (2016). Physical activity perceptions, context, barriers, and facilitators from a Hispanic child's perspective. *International Journal of Qualitative Studies in Health and Well-being*, *11*(1), 31949. http://doi.org/10.3402/qhw.v11.31949

Rowe, D. A., Mahar, M. T., Raedeke, T. D., & Lore, J. (2004). Measuring physical activity in children with pedometers: Reliability, reactivity and replacement of missing data. *Pediatric Exercise Science*, *16*(4), 343–354. http://doi.org/10.1123/pes.16.4.343

Rudd, J. R., Barnett, L. M., Farrow, D., Berry, J., Borkoles, E., & Polman, R. (2017). The impact of gymnastics on children's physical self-concept and movement skill development in primary schools. *Measurement in Physical Education and Exercise Science*, *21*(2), 92–100. http://doi.org/10.1080/1091367X.2016.1273225

Schlinkert, C., & Koole, S. L. (2018). Self-restraint spillover: Inhibitory control disrupts appetite regulation among ruminators. *Journal of Personality*, *85*(5), 825–840. http://doi.org/10.1111/jopy.12357

Shaw, Z. A., Hilt, L. M., & Starr, L. R. (2019). The developmental origins of ruminative response style: An integrative review. *Clinical Psychology Review*, *74*, Article 101780. https://doi.org/10.1016/j.cpr.2019.101780

Shea, T. L., Tennant, A., & Pallant, J. F. (2009). Rasch model analysis of the depression, anxiety and stress scales (DASS). *BMC Psychiatry*, *9*(1), 21. http://doi.org/10.1186/1471-244X-9-21

Sheeran, P., Bosch, J. A., Crombez, G., Hall, P. A., Harris, J. L., Papies, E. K., & Wiers, R. W. (2016). Implicit process in health psychology: Diversity and promise. *Health Psychology*, *35*(8), 761–766. http://doi.org/10.1037/hea0000409

Sheeran, P., Klein, W. M., & Rothman, A. J. (2017). Health behaviour change: Moving from observation to intervention. *Annual Reviews of Psychology*, *68*(1), 573–600. http://doi.org/10.1146/annurev-psych-010416-044007

Simpson, D., Suarez, L., Cox, L., & Connolly, S. (2018). The role of coping strategies in understanding the relationship bewteen parental support and psychological outcomes in anxious youth. *Child and Adolescent Social Work Journal*, *35*(4), 407–421. https://doi.org/10.1007/s10560-018-0531-y

Smith, B., & McGannon, K. R. (2018). Developing rigor in qualitative research: Problems and opportunities within sport and exercise psychology. *International Review of Sport & Exercise Psychology*, *11*(1), 101–121. https://doi.org/10.1080/1750984X.2017.1317357

Smith, J. M., & Alloy, L. B. (2009). A roadmap to rumination: A review of the definitions, assessments and conceptualization of this multifaceted construct. *Clinical Psychology Review*, *29*(2), 116–228. http://doi.org/10.1016/j.cpr.2008.10.003

Sparkes, A. C., & Smith, B. (2009). Judging the quality of qualitative inquiry: Criteriology and relativism in action. *Psychology of Sport and Exercise*, *10*(5), 491–497. https://doi.org/10.1016/j.psychsport.2009.02.006

Sprengeler, O., Wirsik, N., Hebestreit, A., Herrmann, D., & Ahrens, W. (2017). Domain-specific self-reported an objectively measured physical activity in children. *International Journal of Environmental Research and Public Health*, *14*(3), 242. http://doi.org/10.3390/ijerph14030242

Stanley, R. M., Boshoff, K., & Dollman, J. (2013). A qualitative exploration of the "critical window": Factors affecting Australian children's after-school physical activity. *Journal of Physical Activity and Health*, *10*(1), 33–41. http://doi.org/10.1123/jpah.10.1.33

Stevens, J. (2002). *Applied multivariate statistics for the social sciences* (4th ed.). Lawrence Erlbaum Associates Publishers.

Streiner, D. L., & Norman, G. R. (2008). *Health measurement scales: A practical guide to their development and use* (4th ed.). Oxford University Press.

Tennant, A., & Conaghan, P. G. (2007). The Rasch measurement model in rheumatology: What is it and why use it? When should it be applied, and what should one look for in a Rasch paper? *Arthritis and Rheumatism*, *57*(8), 1358–1362. http://doi.org/10.1002/art.23108

Thayer, J. F., Hansen, A. L., Saus-Rose, E., & Johnsen, B. H. (2009). Heart rate variability, prefrontal neural function and cognitive performance: The neurovisceral integration perspective on self-regulation, adaptation, and health. *Annals of Behavioral Medicine*, *37*(2), 141–153. https://doi.org/10.1007/s12160-009-9101-z

Wang, Y., Cai, L., Wu, Y., Wilson, R. F., Weston, C., Fawole, O., Bleich, S. N., Cheskin, L. J., Showell, N. N., Lau, B. D., Chiu, D. T., Zhang, A., & Segal, J. (2015). What childhood obesity prevention programmes work? A systematic review and meta-analysis. *Obesity Review*, *16*(7), 547–565. http://doi.org/10.1111/obr.12277

Wegner, D. M. (1994). Ironic processes of mental control. *Psychological Review*, *101*(1), 34–52. https://doi.org/10.1037/0033-295X.101.1.34

Weng, L.-J. (2004). Impact of the number of response categories and anchor labels on coefficient alpha and test-retest reliability. *Educational and Psychological Measurement*, *64*(6), 956–962. http://doi.org/10.1177/0013164404268674

Whitmer, A. J., & Gotlib, I. H. (2013). An attentional scope model of rumination. *Psychological Bulletin*, *139*(5), 1036–1061. https://doi.org/10.1037/a0030923

Wilson, M. (2005). *Constructing measures*. LEA Publishers.