

Validity and reliability of a pictorial instrument for assessing perceived motor competence in Portuguese children

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Abstract

Background It is important to assess young children's perceived Fundamental Movement Skill (FMS) competence in order to examine the role of perceived FMS competence in motivation toward physical activity. Children's perceptions of motor competence may vary according to the culture/country of origin; therefore, it is also important to measure perceptions in different cultural contexts. The purpose was to assess the face validity, internal consistency, test–retest reliability and construct validity of the 12 FMS items in the Pictorial Scale for Perceived Movement Skill Competence for Young Children (PMSC) in a Portuguese sample.

Methods Two hundred one Portuguese children (girls, $n = 112$), 5 to 10 years of age (7.6 ± 1.4), participated. All children completed the PMSC once. Ordinal alpha assessed internal consistency. A random subsamples ($n = 47$) were reassessed one week later to determine test–retest reliability with Bland–Altman method. Children were asked questions after the second administration to determine face validity. Construct validity was assessed on the whole sample with a Bayesian Structural Equation Modelling (BSEM) approach. The hypothesized theoretical model used the 12 items and two hypothesized factors: object control and locomotor skills.

Results The majority of children correctly identified the skills and could understand most of the pictures. Test–retest reliability analysis was good, with an agreement ration between 0.99 and 1.02. Ordinal alpha values ranged from acceptable (object control 0.73, locomotor 0.68) to good (all FMS 0.81). The hypothesized BSEM model had an adequate fit.

Conclusions The PMSC can be used to investigate perceptions of children's FMS competence. This instrument can also be satisfactorily used among Portuguese children.

Keywords

construct validity, face validity, internal consistency, perceived fundamental motor skill competence, physical activity

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Introduction

Perceptions of physical competence are an important correlate of physical activity in children and adolescents (Babic *et al.* 2014). Stodden and colleagues hypothesized that perceived competence was a mediator between actual skill competence and physical activity behaviour (Stodden *et al.* 2008). More competent children are said to develop higher perceptions of their competence and this translates to more active behaviour. More recent research has confirmed that this relationship applies in older children and adolescents (Barnett *et al.* 2008; Barnett *et al.* 2011; Robinson *et al.* 2015). It is unclear though what specific role perceived Fundamental Movement Skill (FMS) competence has in physical activity behaviour. By assessing young children's perceived FMS competence, it is possible to examine when children's perceived and actual skill competencies start to align (Barnett *et al.* 2015b; Liong *et al.* in press) and then determine the importance of perceived FMS competence on children's motivation for physical activity (Barnett *et al.* 2015a).

Ideally, assessment of perceived FMS competence should align with accepted measures of actual FMS competence, as this allows for better understanding of the relationships between skill competency and perception and how these might differ according to culture. Previous research has established the test–retest, internal reliability and face validity of the Pictorial Scale for Perceived Movement Skill Competence for Young Children (PMSC) (Barnett *et al.* 2015b). This instrument was built on the strengths of an existing pictorial instrument designed to assess physical self-perception in young children (Harter & Pike 1984), but specifically matched the 12 skills assessed in the Test of Gross Motor Development (TGMD-2) (Ulrich 2000). The TGMD-2 was developed in the United States and provides norm- and criterion-referenced interpretations based on a large sample. Test validity only extends to the population it is drawn from; hence, it is important to test the instrument validity before using it outside of its original population. The TGMD two-factor model of object control and locomotor skills has been validated for typically developing children in several countries outside the USA, including Australia (Rudd *et al.* 2015), Brazil (Valentini 2012), China (Wong & Yin Cheung 2010), South Korea (Kim *et al.* 2014) and Portugal (Saraiva *et al.* 2007). Cultural differences have emerged – for instance, in Brazil, children performed below the TGMD-2 American norms (Spessato *et al.* 2012). This suggests that it is useful to use the same instrument across different populations to begin to understand cultural differences in FMS development.

Children's perceptions of motor competence may also vary according to the culture/country of origin. The instrument was initially designed and developed with Australian children; therefore, it needs to be tested in other populations to enhance its utility as a global tool. Even though it is a pictorial instrument, the verbal instructions need to be translated and it is important to know whether children understand the images and the skill performances they portray. Therefore, the purpose of this study was to test the face validity, reliability (internal consistency and test–retest) and construct validity of the PMSC in a Portuguese sample. Furthermore, whilst the construct validity of the full 18 item scale (includes perceptions in six physical activities not considered FMS) of this instrument has been investigated (Barnett *et al.* 2016), construct validity of the 12 FMS items has not. Thus, the second purpose of this paper was to assess construct validity of the 12 FMS items.

Method

Instrument translation

The pictorial instrument designed by Barnett *et al.* (2015b) to assess perceived FMS competence was translated from English to the Portuguese language by two specialists, then a back translation to English was completed by another two specialists, who did not have access to the original English version. These back translations were read by one author (an English native speaker) who made some suggestions for language adjustment to better reflect the intention. Then the two translated versions to Portuguese were semantically adjusted by the Portuguese authors of this paper in agreement with the four specialists. A final translated and edited score sheet was developed. No changes on the FMS item drawings and scoring system were made.

Participants

In 2014, four schools in Portugal (two schools in an inland region and the others two in a region near the sea) were approached as a convenience sample and all agreed to participate. Permission was obtained from the respective school director, and parents or guardians gave informed consent and children assented. A total of 201 children (girls, $n = 112$), 5 to 10 years of age (7.6 ± 1.4), consented. Some parents' refusals resulted in a 95% consent rate. All children were assessed in their attended school. Trained research assistants, supervised by one of the researchers, assessed the

participants. This study was approved by the ethics committee of the institution of the first author.

Design and measures

Children were assessed using the 12 FMS items from the PMSC developed by Barnett *et al.* (2015b). This instrument assess children's perceived FMS competence in the same six object control (striking a stationary ball, stationary dribble, kick, catch, overhand throw and underhand roll) and six locomotor (run, gallop, hop, leap, horizontal jump and slide) skills as the TGMD-2.

Children were initially asked if they had tried the skill previously. Children who had tried the skill were instructed to choose which picture they felt looked like them; then for their chosen picture they were asked to rate their perceived competence. An example of the pictures are shown in Fig. 1. The two options for the 'good' picture were 'really good at...' (assigned a score of four) or 'pretty good at...' (three points), while the options for the 'poor' picture were 'sort of good at...' (two points) or 'not that good at...' (one point) (Barnett *et al.* 2015b). Accordingly, perceived competence for each skill is rated on a 4-point scale. If they had not tried the skill they were asked to imagine what they would be like if they did the skill and still respond to the item. Scores for each skill were summed into object control and locomotor subscales (scores range: 6–24) and all 12 skills (score range 12–48). The authors of the original instrument (Barnett *et al.* 2015b) found in an Australian sample acceptable face validity, good test–retest reliability (object control ICC=0.78, locomotor ICC=0.82 and all 12 skills ICC=0.83) and adequate internal consistency (alpha range = 0.60–0.81).

At first all participants were assessed, then one week later a random subsamples (randomized at the class level) ($n=47$) were reassessed to determine reliability. As recommended by Barnett *et al.* (2015b), skills were demonstrated by the assessor if children could not identify the skill from the picture and verbal cue.

After another week a face validity questionnaire was applied to all 201 participants. This questionnaire had a series of questions for each skill as per the original face validity investigation of this instrument (Barnett *et al.* 2015b). Initially, for each picture children were asked to identify the skill being shown, to check if the children recognized the skills represented. The child's response was recorded as correct or incorrect identification of each skill. Next, children were asked: 'what sport/game/activity is the picture showing?', which was used to ascertain whether children thought the skill came from

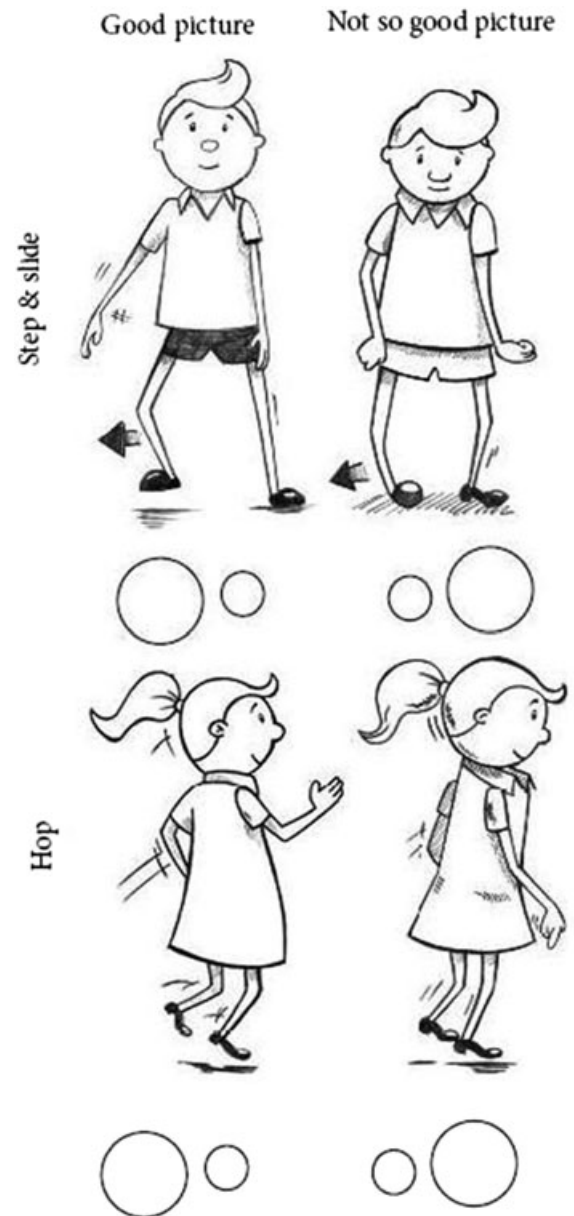


Figure 1. An example of the pictures of the skills shown to children.

a particular sport/activity or was more general. Children's answers were categorized as: 'Does not Know', 'Generic Activity' and 'Specific Sport or Activity'. Children were subsequently asked "which is the 'good picture and which is the 'not so good' picture?" The correct and incorrect identification of pictures was then recorded. The follow-up question was "what is it that makes one picture good and one 'not so good?'" All children's responses to this question were translated and then categorized according to the following categories: (i) appeared to correspond to correct skill

execution; (ii) did not appear to correspond to correct skill execution; or (iii) indicated confusion (Barnett *et al.* 2015b).

Data analysis

The percentage of children who had tried each FMS, and the response for each category (i.e. 'really good' and 'pretty good'), was determined. Also, the same was done for children who correctly/incorrectly identified each picture skill, identified the sport/game/activity for each picture skill, correctly identified the 'good picture' and 'not so good picture' and identified the factors that made one picture good and one not so good. In the case of FMS that were tried by less than 80% of children, the difference in response between those who had tried each FMS item and those who had not was tested with a chi-squared test.

Internal consistency was assessed using ordinal, polychoric correlation-based alphas, which provide a better estimate of reliability than Cronbach's alpha for binary and ordinal response scales (Gadermann *et al.* 2012). As with Cronbach's alpha, ordinal alphas greater than 0.7 may be interpreted as showing acceptable internal consistency. The ordinal alpha values were calculated for the six object control skill items, and for the six locomotor skill items, in order to determine how well the different skill items measure each of two subtests.

Test–retest reliability was determined on the subsample ($n = 47$) using Bland–Altman method (Bland & Altman 1986; Nevill & Atkinson 1997).

Construct validity was assessed using a Bayesian Structural Equation (BSEM) approach. The hypothesized theoretical model used the 12 items and two hypothesized factors (6–6 items): object control (*bounce, catch, hit, kick, throw* and *roll*) and locomotor (*gallop, hop, jump, leap, run* and *step slide*). The factors were allowed to correlate because perceived competence among object control and locomotor skills are not considered independent from each other. The 12 items were modelled as categorical variables. The ratio of sample size to free parameters in the model was more than acceptable, being approximately 3:1, exceeding the minimum ratio of 5:1 recommended by Bentler and Wu (2002).

A BSEM approach was used because of known issues with ML-based Confirmatory Factor Analysis. One issue was the ignoring of significant χ^2 test results as oversensitive for large samples, and the second issue was the unrealistic model constraints from ML-based Confirmatory Factor Analysis (Fong & Ho 2013). The BSEM approach allows cross loadings to be greater than zero, which reflects a real-world scenario. For instance, it is reasonable to expect that perceptions in an object control item might have some relationship (reflected by

allowing the cross loading to differ from zero) with perceptions from a locomotor item. Also, BSEM better accommodates skewed distributions.

A priori model was estimated for the two-factor models: non-informative priors (termed Model 1) and informative priors (cross-loadings) with zero-means and small variances equal to .01 (Model 2) (Fong & Ho 2013). Model estimation was performed using the Markov chain Monte Carlo algorithm and Gibbs Sampler with 60 000 iterations with the first 10 000 iterations as burn-ins. More technical details of the Bayesian SEM approach are described in Asparouhov and Muthén (2012).

Model convergence was assessed with the potential scale reduction factor diagnostics as recommended by Fong and Ho (2013). A value of 1.1 or smaller is considered as evidence of convergence. The posterior predictive p -value and positive 95% credibility interval (Muthén & Asparouhov 2012), assessed model fit, where a low posterior predictive p -value ($P < 0.05$) and a positive 95% lower limit suggest a poor fitting model. The BSEM was carried out using MPlus 7 (Muthén & Muthén 2012). Data and scripts are available from the corresponding author upon request.

Results

Descriptive statistics

Table 1 presents the percentages of children who had previously tried each FMS item, and their perceptions of how good they were at each skill. 'Hitting a ball' had the lowest proportion of children who had tried it, with all the other skills tried by more than 80% of the children. Children who had previously tried hitting a ball rated themselves significantly more favourably than children who had not [$\chi^2_{(3)} = 12.61$, $P = 0.006$]. For the locomotor skills, a large majority of children reported they were really good at the 'step & slide', while less than half of the children reported they were really good at the 'gallop'. For object control skills, more children reported being really good at 'bouncing a ball', with the fewest children reporting they were really good at 'hitting a ball'.

Face validity

Tables 2 and 3 presents the face validity results. In general, most of the children correctly identified each skill. However, for the gallop and 'hop', the percentage of children that did not correctly identify the skill was fairly high, 38.9 and 39.9%, respectively (Table 2).

Table 1. Children who had tried each FMS item, and the percentage for each skill as to 'how good' children thought they were

| FMS | Tried item (%) | Not too good (%) | Sort of good (%) | Pretty good (%) | Really good (%) |
|-----------------------|----------------|------------------|------------------|-----------------|-----------------|
| Locomotor skills | | | | | |
| Run | 100.0 | 1.5 | 5.0 | 20.4 | 73.1 |
| Gallop | 89.1 | 6.5 | 27.4 | 25.9 | 40.3 |
| Hop | 99.0 | 2.5 | 12.4 | 21.4 | 63.7 |
| Leap | 90.0 | 3.0 | 16.2 | 21.2 | 59.6 |
| Jumping forwards | 94.0 | 1.5 | 10.5 | 25.5 | 62.5 |
| Step and slide | 94.5 | 1.5 | 3.5 | 14.4 | 80.6 |
| Object control skills | | | | | |
| Hitting a ball | 37.8 | 8.5 | 37.8 | 24.9 | 28.9 |
| Bouncing a ball | 92.0 | 3.0 | 8.0 | 18.0 | 71.0 |
| Kick | 97.5 | 1.5 | 7.0 | 21.5 | 70.0 |
| Catch | 97.5 | 2.0 | 11.4 | 25.9 | 60.7 |
| Overhand throw | 89.1 | 4.5 | 17.9 | 28.4 | 49.3 |
| Underhand roll | 84.1 | 0.5 | 12.4 | 28.4 | 58.7 |

The percentage of correct answers to the question concerning identification of the 'good picture' and 'not so good picture' ranged between 74.2 for gallop to 100% for 'run'. The percentage of children that did not associate the locomotor skills to any sport/game/activity varied between 54.7% for run to 92.2% for gallop. The percentages for the object control skills were lower (reflecting a higher perspective of applicability to sports and games) and varied between 21.5% for the 'kick' to 66.9% for the 'underhand roll' (Table 2).

The majority of children understood what represented a good and not so good execution in all FMS (Table 3). For instance, for the overhand throw: (good picture) '*He is looking forward, the arm is straight and then moves, the legs are straight, the ball goes ahead and faraway*'; (poor picture) '*He is looking down, the arms are not moving and are down, the legs are a little*

bent and the upper body is also bent, the ball goes to the floor and he toss the ball slowly'. Likewise, an example for leg movement and foot contact with ball of kick: '*One leg is correctly bent with foot on floor and the other is straight kicking the ball*'; '*He touched the ball with instep*'. There was more misinterpretation in the locomotor skills compared with the object control skills; even so, relatively few children misinterpreted the locomotor skill pictures. The exception seems to be the pictures of the gallop. In fact, the percentage of children whose answers indicated confusion is higher for this skill than the percentages of children whose answers appear to correspond to correct skill execution (48.3 versus 45.6%). We observed that some children requested a demonstration of gallop, which indicated that it was not well known to the children.

Table 2. Face validity results: correct/incorrect identification of skills, relation of the skill to a specific sport/game/activity and understanding of pictures

| | Identification of skills | | 'What sport/game/activity is the picture showing?' | | | Understood picture |
|-----------------------|--------------------------|-------------|----------------------------------------------------|----------------------|-----------------------------|--------------------------------|
| | Incorrect (%) | Correct (%) | Does not know (%) | Generic activity (%) | Specific sport/activity (%) | Which is good and not good (%) |
| Locomotor skills | | | | | | |
| Run | 13.3 | 86.7 | 54.7 | 27.1 | 18.2 | 100.0 |
| Gallop | 38.9 | 61.1 | 92.2 | 6.7 | 1.1 | 74.2 |
| Hop | 39.9 | 60.1 | 80.0 | 13.3 | 6.7 | 93.5 |
| Leap | 11.2 | 88.8 | 66.5 | 22.3 | 11.2 | 95.4 |
| Jumping forwards | 4.4 | 95.6 | 84.4 | 13.9 | 1.7 | 98.3 |
| Step and slide | 13.3 | 86.7 | 83.7 | 10.1 | 6.2 | 89.9 |
| Object control skills | | | | | | |
| Hitting a ball | 8.3 | 91.7 | 56.2 | 1.7 | 42.1 | 98.3 |
| Bouncing a ball | 6.6 | 93.4 | 24.6 | 2.8 | 72.6 | 91.1 |
| Kick | 1.1 | 98.9 | 21.5 | 2.2 | 76.2 | 96.1 |
| Catch | 13.8 | 86.2 | 51.7 | 8.3 | 40.0 | 86.0 |
| Overhand throw | 2.2 | 97.8 | 65.6 | 8.3 | 26.1 | 98.9 |
| Underhand roll | 3.4 | 96.6 | 66.9 | 6.6 | 26.5 | 97.8 |

Table 3. Face validity results: children's understanding of what represented a 'good' and 'not so good' skill execution

| 'What is it that makes one picture 'good' and one 'not so good?' | | | |
|-------------------------------------------------------------------------|--------------------------------|------------------------------------------------------------|----------------------------------------------------|
| | Indicates confusion (%) | Did not correspond with correct skill execution (%) | Corresponded to correct skill execution (%) |
| Locomotor skills | | | |
| Run | 17.7 | 2.2 | 80.1 |
| Gallop | 48.3 | 6.1 | 45.6 |
| Hop | 34.4 | 10.6 | 55.0 |
| Leap | 14.4 | 3.9 | 81.9 |
| Jumping forwards | 3.4 | 10.6 | 86.0 |
| Step and slide | 14.9 | 8.3 | 76.8 |
| Object control skills | | | |
| Hitting a ball | 8.8 | 3.3 | 87.8 |
| Bouncing a ball | 9.4 | 9.4 | 81.1 |
| Kick | 6.7 | 7.8 | 85.6 |
| Catch | 19.4 | 7.8 | 72.8 |
| Overhand throw | 4.4 | 6.1 | 89.5 |
| Underhand roll | 7.8 | 6.7 | 85.6 |

Reliability

The Bland–Altman (Bland & Altman 1986) analysis for test–retest reliability for all skills indicates that the 95% limits of agreement between the two measures ranged from -6.57 to 5.95 , with an agreement ratio (Nevill & Atkinson 1997) of 0.99 ($.09$). For the locomotor skills the 95% limits of agreement ranged between -4.77 and 5.04 with an agreement ratio of 1.02 (0.14). For object control skills the 95% limits of agreement ranged between -4.35 and 3.87 with an agreement ratio of 0.99 (0.11).

In terms of internal consistency, the ordinal alpha value for the six object control skill items was 0.73 , and for the six locomotor skill items the value was 0.68 .

Construct validity

The BSEM models with non-informative cross-loadings (Model 1) and informative cross-loadings (Model 2) were both adequate fitting models, though Model 2 (posterior predictive p -value = 0.123) appeared to be slightly superior, (Table 4). Factor loadings in Model 2 for the locomotor factor ranged from 0.48 to 0.78 except for the 'slide' which was

considerably lower (0.32). Factor loadings for the object control factor ranged from 0.50 to 0.75 (Table 5). Informative priors on cross-loadings have a zero mean and variance of 0.01 .

All items were considered ordinal categorical data. The bold values indicate major loadings. All major loadings were statistically significant (p -value < 0.01) with 95% credibility intervals that did not cover zero.

Discussion

The present study examined the face validity, reliability (internal consistency and test–retest) and construct validity of the PMSC, a measure of perceived FMS competence, in a sample of Portuguese children. Barnett *et al.* (2015b) found the instrument was a valid and reliable measure of young Australian children's perceptions of FMS competence. We found that generally the instrument is also valid and reliable for Portuguese children.

The majority of children correctly identified the skills and could understand most of the pictures. A high rate of children could also identify whether and why a picture was a good or not so good representation of the skill. In general, the

Table 4. Bayesian Structural Equation Modelling results for the PMSC for the Portuguese sample ($n = 197$)

| Model | Priors specification | No. of free parameters | 2.5% PP limit | 97.5% PP limit | PP p | No. of Iterations (runtime) |
|-------|----------------------------|------------------------|---------------|----------------|--------|-----------------------------|
| 1 | Non-informative | 49 | -14.19 | 71.85 | $.072$ | 60,000 (7 s) |
| 2 | Informative cross loadings | 61 | -14.22 | 65.419 | $.123$ | 60,000 (6 s) |

PP, posterior predictive; s, seconds.

Table 5. Bayesian Structural Equation Model factor loadings

| Item | Model 1 | | Model 2 | |
|--------|-----------------|----------------|----------------------------|----------------|
| | Non-informative | | Informative cross loadings | |
| | Locomotor | Object control | Locomotor | Object control |
| Run | .486 | — | .480 | .022 |
| Gallop | .461 | — | .489 | -.012 |
| Hop | .626 | — | .621 | -.011 |
| Leap | .765 | — | .775 | .006 |
| Jump | .651 | — | .644 | .008 |
| Slide | .376 | — | .323 | .054 |
| Hit | — | .560 | .023 | .542 |
| Bounce | — | .510 | .015 | .496 |
| Kick | — | .741 | .000 | .753 |
| Catch | — | .479 | -.022 | .501 |
| Throw | — | .630 | .007 | .629 |
| Roll | — | .669 | .010 | .651 |

The bold values indicate major loadings.

comments about the skills revealed that nominally they knew the physical actions/movements required to perform it.

Children did not do as well in terms of relating the skills to their play, physical education and sports. This is important to note as this gives further information on face validity. If children cannot recognize in what context the skill is used they are demonstrating they have less exposure and less understanding of the skill item. The locomotor skills in particular were not well understood in terms of sport applicability. Some locomotor skills like hop and gallop, were particularly poorly understood. This is understandable in some ways, as these skills do not have an obvious connection to any particular sports and activities. This was reflected also in the identification of the pictures, as the gallop was not well identified. The test authors (Barnett *et al.* 2015b) recommend skill demonstration whenever children cannot identify it. The hop and gallop along with the slide were most requested to be demonstrated in the current study. Barnett *et al.* (2015b) also found that the gallop and slide needed to be demonstrated to some children. Therefore, even though the current study has a different cultural context, similar skills were not as easily recognized by the children. This could be because of the drawings of these skills. It is arguably harder to draw a gallop or a slide in a static single image compared with a skill such as a throw or hit. It may be that an animated skill performance would be more understandable to the children. Although it could also be argued that a skill such as the gallop would still not be well recognized in an animated version because of the fact it is not commonly performed by children in their games and play.

In some object control skills children also demonstrated difficulties in allocating the skills to a sport, game or activity. For instance, at least half of the children could not apply the overhand throw, underhand roll, hitting a ball and catching, to a sporting context. An explanation for this could be the types of sports and games children generally play in Portugal. For instance, using a bat to strike a ball (e.g. as in baseball or cricket) is not a skill that Portuguese children regularly perform. Data related to Portuguese population in general show that soccer is the most practiced sport, followed by handball and volleyball (Pordata 2015). This study found soccer was the sport most associated with the kicking skill, which confirms the ubiquity of soccer with regard to kicking a ball in Portugal.

Over 80% of children in this study had tried every skill except for hitting a ball, which implies they have been exposed to these skills. Perhaps, even though the children thought they had tried the skills, they still did not have a clear idea of how those skills might be applied or relate to a sporting context. Children of this age in Portugal (5 to 10 years) do not have contact with formal sports within school as physical education only becomes compulsory after primary school, so this may help to explain the lack of ability to relate skills to a sporting context. Children in Australia do commonly have physical education in primary schools, which may explain why the Australian children in the original validation were more able to relate the skills to sports and activities.

Barnett *et al.* (2016) also found in a recent investigation that nearly all children in their Australian sample had tried most of the skills – except for hitting a ball and the step and slide – which were tried by less than 80% of the sample. In the current study, children who had tried hitting a ball before, rated themselves as more competent at this activity than the children who had not. Similarly to the current study, Barnett *et al.* (2016) found the children who had tried the activity previously, rated themselves as higher. This suggests it is important to ask children if they have tried the activity previously, as this variable can be used potentially as a confounding variable to adjust for in analysis.

Nevertheless, despite the potential low sport literacy of these children, investigation of the construct validity demonstrated that the model was a reasonable fit. It has been suggested that young children (pre-school age) are not able to distinguish different types of competence perceptions. Perceptions of both cognitive and motor competence were investigated by Harter and Pike (1984) in pre-school children and older children. In older children (aged around 9–12 years), Harter found that cognitive competence and motor competence were defined as

separate factors (Harter 1982), whereas pre-school children did not distinguish between cognitive and motor competence (Harter & Pike 1984). This current study provides evidence that children can distinguish between different aspects within the physical domain. Specifically, that skill perceptions can be understood in the constructs of object control and locomotor skill.

In a recent investigation Barnett *et al.* (2016) found that in younger children (mean age of 4 years), whilst children could distinguish FMS perceptions from active play items (e.g. cycling), there was not a clear distinction between all object control and all locomotor items. In fact object control hand skills (i.e. catching and throwing) emerged as a distinct factor and FMS skills with a leg action (i.e. leaping and kicking), another factor. Because the children in the current sample were older, this implies that as children age they start to perceive their ability more in terms of the object control and locomotor factors.

Even though the construct validity was supported there is evidence that not all skills were as useful to the model. The slide was the lowest loading item, which is also reflected in the face validity results in terms of children's lack of understanding of how this skill might apply to sport, and what is a good representation of this skill. Interestingly, whilst children also indicated some confusion with the hop, this item still loaded well on the locomotor factor. Therefore, it is suggested that lower understanding (and/or low loading in the model) for the hop, gallop and slide has not greatly affected the validity of the assessment as a whole. Even so, it is worth thinking of the implications of less child understanding around these skill in future use of this tool. Perhaps, it is not necessary to ask children for their self-perception in all skills used in the TGMD-2, as some skills may be useful for identifying deficit in gross motor skill but not as useful for identifying a deficit in perceived competence.

Test-retest reliabilities for both subscales (locomotor skills and object control skills) and the overall 12 FMS were very good. The authors of the original instrument (Barnett *et al.* 2015b) also found good reliability, calculated as intra-class correlation (0.69 to 0.83). The reported values for internal consistency were reasonable, similar to the values found by Barnett *et al.* (2015b) (alpha range = 0.60–0.81). This suggests that the 12 skills may be divided into two subscales like the TGMD-2. Although, the locomotor scale had a slightly lower internal consistency than that for the object control scale which could reflect the face validity results, with children being less able to relate the locomotor skills to their games and activities.

This is the first study to investigate construct validity of FMS perceptions (as opposed to in relation with active play items) and the first study to investigate validity and reliability of these perceptions outside of Australia. A study strength is the BSEM analysis approach, which is recommended for ordinal skewed data of this nature. Whilst this sample was not a representative sample, it does comprise children of two different regions of Portugal, one near the sea and the other an inland region, so possible cultural differences in Portuguese population are represented, helping generalizability potential.

This study has shown that it is possible to use this scale to investigate perceptions of children's FMS competence. This study also provides confirmation that the instrument can be used in Portugal. Future research may seek to investigate how children's FMS perceptions vary across different cultural contexts and how this relates to actual FMS competence and to health behaviours such as physical activity.

Key Messages

- More competent children are said to develop higher perceptions of their competence, and this translates to more active behaviour.
- This is the first tool developed to measure young children self-perceptions of the same FMS assessed in common tests of actual FMS ability (TGMD-2). Test-retest and internal reliability, and face validity, have been previously established in Australian children (Barnett, Ridgers, Zask *et al.* 2015). Construct validity results confirms the two factors of TGMD-2 (object control and locomotor skills).
- Children's perceptions of motor competence may vary according to the culture/country of origin; therefore, it is also important to measure perceptions in different cultural contexts.
- To understand perceptions motor competence development in a global context, researchers in different countries need to use the same or comparable instruments.
- This instrument can be used to understand how young children perceive their FMS, which will help in knowing how important FMS perceptions are to physical activity behaviour.

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