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Who can best report on children’s motor competence: parents, teachers, or the children themselves?

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Abstract

Objective: A positive perception of motor competence (MC) is important for children’s health trajectory. It is purported that young children’s perception is not well aligned with their actual ability. Alternative sources of perceptions are postulated from children’s social context such as their parents or teachers. This study aims to analyse the associations among children’s, parents’ and Physical Education (PE) teachers’ perception of children’s MC and the children’s actual MC, and whether these sources of information can report on children’s actual MC.

Design and Method: A convenience sample of 139 typically developed children (48.2% girls) from six schools participated in this cross-sectional study. Actual and perceived MC was assessed by using the Test of Gross Motor Development and the Pictorial Motor Skill Competence scale, respectively. Spearman’s rho correlation and multilevel mixed-effects linear regression models were conducted.

Results: Weak, weak-moderate and moderate positive association was found between children’s, parents’ and PE teachers’ reports and children’s MC ($p < .05$), respectively. Children presented limited capability in explaining their actual MC. Parents’ and PE teachers’ proxy reports on children’ MC were possible predictors of children’s MC, with PE teachers best able to report on children’s MC.

Conclusion: Taking into account the resources needed to objectively assess children’s actual MC, this study offers alternative sources of information for educators, researchers and/or therapists to assist in reporting children’s actual MC.

Key words: motor competence, perception, childhood, gender, age.
Motor competence (MC) is a broad concept which encompasses fundamental movement skill (FMS) level, i.e. locomotor and object control skills (Gallahue, Ozmun, & Goodway, 2012). MC has been identified as relevant for young people to be active physically in their daily life (Robinson et al., 2015; Stodden et al., 2008). MC in childhood also tracks to later adolescent movement skill mastery (Barnett, van Beurden, Morgan, Brooks, & Beard, 2009; Gallahue et al., 2012).

During recent years there is more evidence to show that a positive perception of physical competence is also very important to a child’s health trajectory (Jekauc, Wagner, Herrmann, Hegazy, & Woll, 2017; Robinson et al., 2015). Children’s perception of physical competence is important for their well-being, social acceptance, general participation in play, and willingness to participate in physical education (PE) and physical activities in general (Ntoumanis, 2001; Stodden et al., 2008). Systematic review evidence shows children with high levels of perceived physical competence are more likely to engage in physical activity (Babic et al., 2014).

In relation to self-perception, children form their beliefs by interpreting information from four sources of self-perception (Bandura, 1997): (1) mastery experience, 2) vicarious experience, 3) social persuasion from significant others and 4) physiological states. Among the determinants of why individuals are physically active or inactive, significant others play a relevant role in affecting children’s behaviour (Jekauc et al., 2017; Ramanathan, O’Brien, Faulkner, & Stone, 2014; Rivard, Missiuna, Hanna, & Wishart, 2007; Stodden et al., 2008). However, little is known about whether the development of MC could be influenced by the significant others (Laukkanen, Pesola, Heikkinen, Sääkslahti, & Finni 2015). In particular, parental influence has comprised only a minor area of study in efforts to enhance MC in children, making it difficult to interpret the role of parents on the outcomes (Laukkanen et al., 2015).
Studies conducted on the analysis of social correlates were mainly focus on preschool children (Iivonen & Sääkslahti, 2014), finding that significant others (e.g., parents and teachers) can affect children’s MC in both boys and girls (Iivonen & Sääkslahti, 2014). In this line, children themselves and their significant others (e.g., parents and educators) can provide valuable insight regarding children’s actual MC (Lalor, Brown, & Murdolo, 2016). It is therefore recommended to create a comprehensive and thorough picture of children’s actual MC by considering both children’s and significant others’ views (Kennedy, Brown, & Chien, 2012).

Theoretically, it is purported that due to the limited development in children’s cognition influencing their accuracy in self-perception (Barnett, Vazou, et al., 2016), young children’s perceptions of their own physical competence is not well aligned with their actual ability. From a developmental approach two reasons are offered: a) young children may perceive effort as mastery, and have not yet integrated their own performance in relation to others (Harter, 1999; Stodden et al., 2008). b) Young children confuse the wish to be competent with the reality (Harter & Pike, 1984), so until eight years-old they do not seem to be capable to report self-judgements accurately. Interestingly, it is noted that as children age their reflection of their own MC will align better with their actual performance (Stodden et al., 2008). Moreover, it seems that when appropriate instruments are used (those adapted to the children’s cognitive ability), such as pictorial scales, young children can make more reliable judgements about their competence (Harter & Pike, 1984; Ruiz-Pérez & Graupera, 2005). In this line, studies conducted in primary school (Barnett, Ridgers & Salmon, 2015; Liong, Ridgers & Barnett, 2015) by using pictorial scales, found children are able to report on their MC but their accuracy in reporting MC may be also affected by the sex and the type of movement skill (i.e., locomotion or object control skills). Thus, taking into
account that childhood is a key period for the development of MC (Gallahue, Ozmun, & Goodway, 2012) and seems critical for the children’s capability in making reliable judgements about their MC (Ruiz-Pérez & Graupera, 2005), the study of children’s actual and perceived MC should consider that age, sex and type of FMS can provide an insight to children’s motor development.

Until recently, assessment of young children’s MC did not align with assessment of perceived MC (i.e. children may be assessed objectively in a catch but asked about their perception in a different task). Therefore, studies in this area have generally not compared ‘apples with apples’ in terms of the relationship between physical self-perception and actual MC (e.g. Kennedy et al., 2012; LeGear et al., 2012; Toftegaard-stoeckel, Groenfeldt, & Andersen, 2010). A recent study showed children around eight years-old with low perceived MC (in this case, athletic competence) were less autonomously motivated for sports and had a lower global self-worth than children with high perception, even if they had high actual MC (Bardid et al., 2016). Other studies using directly aligned assessments (i.e., perception of a catch and actual assessment of a catch) have found weak to moderate associations between perceived and actual MC in young children, with a suggestion that object control skill has better alignment (Liong et al., 2015).

Regarding the information from significant others, Bandura (1997) stated that social persuasion interacts with children’s own perception, and this may consequently affect the children’s actual MC (Jekauc et al., 2017; Laukkanen et al., 2015; Liong et al., 2015). Social persuasion includes exposure to the verbal and nonverbal judgments that others provide (Britner & Pajares, 2006) by encouraging (or not) children to engage in activities that promote movement competency (Bangsbo et al., 2016; Eddolls, McNarry, Stratton, & Mackintosh, 2016; Haywood & Getchell, 2005; Liong et al., 2015).
2015). Significant others could therefore be integral to cultivating children’s positive perception of their MC. In this line, parents of children with better MC seem to perceive their children’s athletic competence to be higher than the perception of parents whose children showed poorer movement skill (O’Neill et al., 2014).

Furthermore, educators may also be capable in identifying children with low perceived competence (Toftegaard-Stoeckel et al., 2010). Teachers are often the initial source of referral in cases when poor MC development is noticed (Rivard et al., 2007). Hence, despite the important role that significant others may play in the development of children’s MC (Liong et al., 2015), only one study to date has analysed children, parents and teachers’ perception of children’s MC; finding parents predicted children’s manual coordination, agility and strength, and teachers predicted children’s body coordination but not manual coordination, agility or strength (Lalor et al., 2016). Nonetheless, this study involved general classroom teachers, not teachers of PE. Other studies have demonstrated that PE teachers can identify pupils’ MC accurately, even in pupils who are low motor competent (Ruiz-Pérez, Graupera, & Gutiérrez, 2001). Also, PE teachers are able to help children enhance their self-competence (Breslin, Murphy, McKee, Delaney, & Dempster, 2012). However, whilst significant others’ capability in reporting children’s MC appears to be a dependable and formative source of report (Lalor et al., 2016), parents and teachers may think that a child with poor motor skills could reflect a kind of incompetence in their parenting or teaching abilities, thereby introducing social-desirability bias (Fisher & Katz, 2000).

Taking into account that those children who are limited in MC will not have the prerequisite skills to be active (Clark, 2005; Clark & Metcalfe, 2002), research assessing MC in children must pay attention to understanding the relevance of children themselves and significant others (Stodden et al., 2008) as potential sources of
information regarding children’s actual MC (Weiss & Amorose, 2005). Thus, the purpose of the current study was to analyse the associations among children’s, parents’ and PE teachers’ perception of children’s MC and the children’s actual MC, and whether children, parents and PE teachers can report on children’s actual MC considering the children’s age, sex and the type of FMS. This holistic perspective may allow researchers to recognise which one of these sources provide a better insight into children’s actual MC.

Method

Participants

A cross-sectional design was used to study children’s MC from 6 to 11 years old. A convenience sample of 139 (consent rate of 79.6%) typically developing children (48.2% girls) from six schools in Spain participated (45 children aged between 6 and 7 years-old; 31 aged between 7 and 8 years-old; 12 aged between 8 and 9 years-old; 36 aged between 9 and 10 years-old; and 15 aged 10 or 11 years-old). Schools were selected based on having a diversity of schools (three public and three private; two from coastal cities and four from inland). Previous studies in the field calculated a sample size of 20 children for predictive analyses in actual MC (Lalor et al., 2016); in the current study this sample was considered as the minimum for both sexes. Table 1 presents descriptive socio-demographic information regarding children. Educative centres, PE teachers and parental or guardian consent to participate in the study were obtained and children assented prior to participation. Approval was obtained from the Institutional Review Board of the corresponding author’s University (H1446557620395).

Procedure
Before children’s assessment, proxy (parents and PE teachers) reports were carried out at home or school (January, 2016). Parents and PE teachers attended a full session wherein explanation and training in how to complete the proxy report was provided. Assistance was also provided by phone or e-mail when required. It is mandatory in the Spanish educative system that those teachers who are not permanent at a specific school change school every year. Therefore, in order to guarantee teachers’ ability to provide a proxy report on their students, only PE teachers who were a direct tutor of pupils were invited into the study (i.e., four PE teachers mainly in 1st and 2nd grade from three schools; children’s age range 6-9 years). Children’s actual and perceived motor competence were assessed by using the Test of Gross Motor Competence third version (TGMD-3; Maeng, Webster, & Ulrich, 2016) and the Pictorial Motor Skill Competence (PMSC; based on the TGMD second version (Barnett, Vazou, et al., 2016)) scale, respectively. Data assessments (February-April, 2016) were carried out in their respective school in one session per child. Children’s actual MC was rated once the MC was videoed from the whole sample was recorded.

**Instruments**

The TGMD-3 (Maeng et al., 2016) was used to assess children’s proficiency in two components of the FMS, the locomotion and the object control (i.e., ball skills). It must be noted that in the third version of this instrument, the leap and underhand roll are not included and the skip, one-hand forehand strike, and underhand throw were added, bringing the total skill count up to thirteen from the previous twelve. Each participant completed all 13 skills that conform to the TGMD-3; for each skill, task components were marked as ‘present’ = 1 or ‘absent’ = 0. The total score in every task component provides an outcome of skill level. The sum of every skill in each of the two components (i.e., locomotion & object control skills) informs the total skill proficiency,
also known as MC; the score range for the total scale was 0–100, with subscales ranging from 0–46 in locomotion and from 0–54 in object control skills. This test has excellent reliability in children from different cultures, including the Spanish context wherein evidence of validity has been recently found for children aged 3-11 years-old (Estevan et al., 2017).

To assess children’s perceived MC, the PMSC scale was used (Barnett, Vazou, et al., 2016). It is composed by twelve pictographic tasks; matched to the twelve skills in the TGMD second version (Ulrich, 2000). Each subscale (i.e., the locomotor and object control) was evaluated by six skills (i.e., run, gallop, leap, hop, slide, and jumping forward for locomotion, and strike with two hands, stationary dribble, catch, kick, overhand throw and underhand roll for object control). Thus, the perceived competence for each of the twelve skills in the PMSC was rated on a 4-point scale (with a higher score reflecting high perceived competence) using a double dichotomization process. That is, firstly children are required to choose between the picture depicting a child who is competent in a skill and the picture depicting a child who is not so competent in a skill (Figure 1). Thus, children are presented with the first dichotomized choice between two pictures (a good or a poor performance of a skill). Once they have made their decision they must choose again between two choices (second dichotomized choice). 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). The range of scores for the total scale was 12-48, with subscales ranging from 6–24 (i.e., locomotion & object control). This scale has acceptable internal consistency, test-retest reliability and construct validity for Australian (Barnett, Vazou, et al., 2016; Barnett, Ridgers, Zask, & Salmon, 2015), Brazilian (Valentini, Zanella, & Webster, 2017), Portuguese (Lopes et
al., 2016) and Spanish (Estevan et al., in press) children. Internal consistency for
children, parents and teachers are reported in Table 2.

Parents’ and PE teachers’ also rated the children’s MC using an adaptation of
the PMSC. The original scale was transformed into a written survey to be completed.
Each skill was named and had an accompanying image. This survey was then pilot
tested with parents for face validity (Liong et al., 2015). This scale is based on the same
4-point Likert scale as used in the child version: 1 being ‘not good at’ and 4 being ‘very
good at’. The range of scores for the total scale and subscales was thus the same as in
the version for children. Test-retest reliability (13.4 days) of this version of the PMSC
was assessed in 21 Australian parents of children aged 6.3 years ($SD = .97$) and found to
be highly reliable (intra-class correlation = .90, 95% CI .77 – .96) (retrieved data from
personal communication with Dr. Lisa Barnett). In the current study, to assess internal
consistency, ordinal, polychoric correlation-based alphas were used. These provide a
better estimate of reliability than Cronbach’s alpha for binary and ordinal response
scales (Gadermann, Guhn, & Zumbo, 2012). The ordinal alpha values were calculated
for the six object control skill items, for the six locomotor skill items and for all 12
items total FMS (see Table 2). This was done using the two samples ($n = 139$ and $n =
67$) for parents’ and for the subsample ($n = 67$) for teachers’ perceptions.

Protocol

Prior to the children’s actual and perceived MC assessment, children’s body mass index
was calculated using weight and height measures obtained by standard stadiometer scale
and a bioelectrical impedance scale (Tanita TBF-410 M). Body mass index percentiles,
adjusted for age and sex (Kuczmarski et al., 2000), were used. After that, a video
demonstration of each skill performed by the research assistant was shown to the child
via a tablet and children were asked if they had tried the skill previously. The research
assistant then provided children who had not tried or recognized the task via the visual
and verbal cue a second live demonstration. The majority of the items were recognized
by the whole sample (only in some cases galloping required an additional
demonstration).

The children’s actual MC assessment (TGMD-3) took place in a large sports
hall. Children attended in pairs to perform the 13 skill tasks, manned by two trained
research assistants who received 6h of training (including practical examples) in the
administration period. Each child was given one practice attempt and two assessment
trials for each skill. No feedback on performance was reported during the
familiarization trials. The tasks were split into locomotive and object control skills.

Every task was video recorded (sagittal view) at 25 Hz by using a Lumix TZ7 camera
(Panasonic, Japan ©) to allow for subsequent coding (not in real time, i.e. videos could
be paused) once all the TGMD records were finished. Prior to the videos of the current
study being rated, intra and inter-rater reliability were conducted for the two raters
involved in the study, by using four videos provided online by the instrument developer
(University of Michigan, School of Kinesiology, 2016). The intra-class correlation
(IICC) coefficient showed excellent reliability with .99 (95% CI .95 – 1.00) for intra-
rater reliability and .92 (95% CI .76 – .98) for inter-rater reliability. Later, from the
sample under study, 20 children’s TGMD videos were selected randomly and coded by
three raters. That is, the two raters involved in the study and a researcher (the first
author of the current study who has high experience in TGMD coding acting as a gold-
standard) conducted a session for qualitative reliability (i.e., consensual agreement).
 Afterwards, the intra and inter-rater reliability analyses were conducted with the two
raters. The ICC also showed excellent reliability with .98 (95% CI .97 - .99) and .90 (95% CI .80 - .94) for intra and inter-rater reliability, respectively.

Perceived MC (PMSC) was assessed after actual MC in a quiet room and administration was carried out according to the protocol of the original scale (Barnett, Ridgers, Zask et al., 2015). Children were instructed to choose which picture they felt looked like them; then for their chosen picture they were asked to rate their perceived competence. The total time for assessing each child’s actual and perceived MC was around 40 minutes.

**Data analyses**

First the main sample of children and parents’ data (n = 139) was analysed, and then the subsample of data aligned with PE teachers’ proxy reports (n = 67). According to the ordinal nature of the PMSC scale, non-parametric tests were considered for analyses; furthermore, this was verified by the Kolmogorov-Smirnov test with some variables not complying with the normality assumption. Spearman’s rho correlation was first performed to determine the associations between the children’s, parents’ and PE teachers’ perception of children’s MC and the children’s actual MC in locomotion, object control, and total FMS.

The reliability analysis was conducted using an R package: *psych*, which can be downloaded as part of the freely available software package R (http://www.R-project.org). Ordinal alpha has been previously used and reported when assessing perceived MC (Barnett, Vazou, et al. 2016) as suggested by Gadermann et al. (2012) and Basto and Pereira (2012).

Multilevel mixed-effects linear regression models were conducted to assess the predictive power of children or parents’ perception of the children’s MC (i.e., locomotion, object control and FMS) on children’s actual MC. The Multilevel mixed-
effects approach was chosen due to the clustered nature of the PE teacher data (i.e. one teacher reporting on multiple pupils and to account for correlation of children within the teachers’ classes). Each model included the teacher as a random effect and was adjusted for: age, sex and an interaction between age and sex [due to age –increasing- and sex –boys- being known positive correlates of MC (Barnett, Lai, et al., 2016)]. Originally, the interaction between perception and age was included but due to this not being significant, it was removed from the final analyses. Robust standard errors were calculated and model assumptions were checked with residual plots and histograms.

Three further multilevel mixed-effects models were conducted with teachers’ perception of children’s MC as the independent variable and children’s actual MC (i.e., locomotion, object control and FMS) as the dependent variable. Significance testing for all analyses was two-sided and was adjusted to account for the multiple models created. A more conservative notional significance level (type I error) of .003 was used (Shaffer, 1995).

To determine the amount of variability possibly explained by the models, the effect size, eta squared ($\eta^2$) and 95% confidence intervals were calculated using ordinary least multiple linear regressions, where $\eta^2 < 0.2$ might be considered trivial; 0.2-0.5 small; 0.5-0.7 moderate and $\eta^2 > 0.7$ large (Cohen, 1988). Moreover, multilevel mixed-effects models were compared using the Akaike's information criterion (AIC) and Bayesian information criterion (BIC). A smaller AIC and BIC value suggests a better model. The modelling was conducted using the statistical software Stata Version 14 (Stata Corp College, Texas, USA) and the Stata command: mixed.

Results
Table 1 presents descriptive statistics of children’s actual MC and children’s, parents’ and PE teachers’ perception of children’s MC. Children’s perception was weak or did not correlate with their actual MC (see Table 2). Parents were able to provide weak-moderate proxy report on children’s MC. PE teachers’ were able to provide moderate proxy report associations on children’s MC.

Table 1 & Table 2

Table 3 shows the results from the mixed effects models for the children’s perception. All results presented are for the relationship between children’s perception and the outcomes: locomotion, object control and FMS and are adjusted by age, sex and a possible interaction effect for age and sex. For the main sample (n = 139) models, there were no statistically significant associations between children’s perception and the children’s actual FMS. An effect for sex (boys) in FMS was found (but not shown in Table 3). For the subsample models, there was a statistically significant association between children’s perception and locomotion (Adj. β = .62, 95% CI [.42, .82], p < .0001, where η² = .20). An effect of age (increasing) in locomotion and FMS, and sex (boys) in object control were found.

Table 3

The linear relationship between parents’ proxy report of children’s MC and the actual children’s MC in locomotion, object control and FMS, respectively, for the main sample and the subsample models shown in Table 4, were all statistically significant (p < .001). The overall η² in ordinal least squares models ranged from .36 to .59 (main sample) and .24 to .39 (subsample). An effect of age (increasing) in locomotion and age (increasing) and sex (boys) in object control and FMS were found, in both the main and subsamples.
Table 4

The three models in which the PE teachers’ proxy report of children’s MC was a possible predictor of the children’s actual MC in locomotion, object control, and FMS, were all statistically significant with $\eta^2$ ranged from .24 to .47 (see Table 5). An effect of sex (boys) in object control was found.

Table 5

Discussion

Proficient motor skills allow children to interact with and explore their surrounding environment, and engage in daily occupations and physical activity (Brown & Lane, 2014). So this study aimed to understand the extent to which children’s, parents’ and PE teachers’ can report on children’s actual MC. Previous theoretical frameworks suggested the importance of children’s and significant others’ perception in children’s behavioural and cognitive processes (Bandura, 1997; Stodden et al., 2008). The results of the current study show parents and PE teachers seem to be able to report on children’s MC to a much better degree than the children themselves. Our study thus confirm the suggestion that parents and PE teachers can offer valuable insight into children’s performance in the children’s natural environment such as at home or school (Lalor et al., 2016).

The association between children’s perceived and actual MC was null or weakly positively associated in object control and FMS. Moreover, the mixed effect model analyses showed children were able to better report on their locomotor skills. The fact we did not find an initial association between perceived and actual MC in locomotion seems to be due to the adjustment factors (i.e., age and sex) that nullified the effect that
was showing for object control in the correlation analysis. This finding is not in line
with recent studies in Australia (Barnett, Lai, et al., 2016; Barnett, Morgan, van
Beurden, & Beard, 2008; Barnett, Ridgers, & Salmon, 2015; Liong et al., 2015) which
found children could report better on object control skills. This is in spite of the fact
young children’s competence in locomotion is associated with physical activity
engagement (Barnett, Salmon, & Hesketh, 2016). It is not clear in the current study why
Spanish children are better able to understand their locomotor competence compared to
Australian children. According to the descriptive data, our results in terms of children’s
perceived MC are similar to those previously reported wherein children scored around
19-20 out of 24 in perceived MC (Barnett, Ridgers, & Salmon, 2015; Liong et al.,
2015). Moreover, in the case of children’s actual MC, despite the use of the TGMD
second version (in the current study we used the TGMD-3), the score in terms of the
percentage achieved of the total available in actual MC was also similar with 65-70% of
the total possible points (Barnett, Ridgers, & Salmon, 2015; Liong et al., 2015). It must
be noted though that the FMS models in the current study were close to significance
indicating that perhaps the current results are not that different to previous studies. It is
clear that young children are just beginning to understand their own skill performance at
this age. These results might support the necessity to analyse alternative sources of
information that can contribute to an insight in the children’s MC such as parents and
PE teachers’ perception of children’s MC (Kennedy et al., 2012).

Seeking a proxy report may be an alternative to child self-report. Parents’
perception of children’s MC showed positive weak to moderate correlations with
children’s actual MC in locomotion, object control and FMS. These findings support
previous studies reporting a moderate association between parent report and children’s
actual MC (Liong et al., 2015), and similar to the current study, the association between
parent report and children’s MC was stronger in object control than in locomotion.

Despite the small or moderate amount of variability explained in each model (parents and children), the AIC and BIC values for parents’ models (Table 4) in locomotion, object control and FMS were smaller than for the children’s models (Table 3), respectively; suggesting they were better models. In line with Lalor et al. (2016), who found that parents’ proxy report explained children’s manual coordination, our results suggest parents’ are able to better recognise these skills consisting of manipulating and projecting an object (object control) rather than those that just involve moving the body through space (locomotion).

PE teachers’ report of children’s MC showed a positive and moderate correlation with children’s actual MC. In addition, similar to parents, in the mixed effects models for the subsample with PE teachers’, the AIC and BIC value was smaller than the values for children’s models locomotor, object control and FMS. Other studies have also noted the ability of PE teachers’ to report on children’s MC (Ruiz-Pérez et al., 2001; Toftegaard-Stoeckel et al., 2010). This supports the use of PE teachers in terms of providing a proxy report of children’s MC (Rivard et al., 2007).

It has been noted that teachers recognise children’s MC according to the type of skill, with higher ability in identifying gross motor rather than fine skills (Lalor et al., 2016). Our study findings might complement this previous study; that is, even though only gross motor skills were assessed, the results indicate PE teachers’ seem to be capable to report object control but specific training is needed to recognise locomotion thoroughly. A systematic review (Morgan et al., 2013) showed FMS could be improved when taught by specialist PE teachers; nonetheless, training in FMS in terms of professional development of PE teachers are still low (Lander, Eather, Morgan, Salmon, & Barnett, 2017). The necessity of training PE teachers in FMS has been recently raised
This specific training can improve PE teachers’ professional competences and, indirectly, it may impact on the children’s physical activity in future.

As children age, their MC increases (Barnett et al., 2008; Gallahue et al., 2012) and the relationship between actual and perceived competence becomes stronger (Jekauc et al., 2017). Even though it was expected that there would be an interaction effect between age and perception, this interaction term was not significant. This shows that within the age ranges of the children in our samples, perception did not align more with actual skill as children aged. Contrary to this perspective, the children in the sub-sample (younger children) offered more consistent (in terms of ordinal alpha) perceptions than the main sample (also involving older children). This may be due to the fact that as children age they are more used to practicing or being involved in complex motor tasks such as the combination of running and bouncing or jumping and throwing (Gallahue et al., 2012). Thus, the fact of asking the older children in the main sample for their competence in single motor tasks (e.g., stationary dribbling, jumping forward or overhand throw in isolation) may affect their perception, because they might consider that they are better in these basic motor tasks than they actually are due to the fact they are used to practicing the aforementioned complex tasks often.

Moreover, children’s and parent’s reports of children’s MC in FMS were affected by the children’s age. In childhood, the influence of age in young children’s MC can be considered as more relevant than in older children or adolescents as this is the period when more rapid change in motor development is occurring (Barnett, Lai, et al., 2016; Gallahue et al., 2012). PE teachers’ reports of children aged 6-9 years-old were not affected by the children’s age. It seems that even though limited professional
training exists in FMS for PE teachers (Lander et al., 2017), their training as a PE teacher provides them the ability to discriminate children’s MC independently of the children’s age. Although more plausibly, this could simply be because teachers are reporting on children in one class group and therefore there is less of an age range and less chance therefore that age will be an influencing factor (Barnett, Lai, et al., 2016).

Systematic review evidence shows that boys have higher object control skill compared to girls (Barnett, Lai, et al., 2016). Our results support this, in that children’s, parents’ and PE teachers’ proxy report of children’s object control skill was affected by the child’s sex. This is further confirmation that parents and PE teachers can identify the children’s object control skill accurately.

The current study has provided valuable insight in terms of children, parents and teachers as sources of information capable of reporting on children’s actual MC. The low numbers of PE teachers in the study could be considered as a limitation in the extrapolation of our results. Moreover, as we did not collect data on the sex of the parent or PE teacher, we could not investigate the potential impact of sex on reporting on children’s MC. Teachers may have different perceptions of the motor abilities of boys and girls and might have stereotypical expectations of their performance level on different types of motor tasks, based on their gender (Rivard et al., 2007). Furthermore, in spite of this study clarifying the relationship between children’s MC and children’s, parents’ and PE teachers’ perception of MC, it must be noted that the PMSC version used is not completely aligned with the TGMD-3 that was used for assessing children’s actual MC. Taking into account that some of the items in actual MC slightly differ with those included in the assessment of perceived MC, future studies should replicate the current study by involving a higher PE teacher sample size and using the two aligned scales (i.e., TGMD and PMSC) based on the same version.
Conclusions

The analysis of different types of FMS (i.e., locomotion and object control) by using specific and directly aligned instruments in relation to perceived and actual MC provide an insight into children’s MC. Among the three sources of information, children present limited ability to report their MC; whereas parents and PE teachers can report better on child competence. Taking into account the resources needed to objectively assess children’s actual MC, this study offers alternative sources of information for educators, researchers and/or therapists to assist in reporting children’s actual MC.
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Table 1

Descriptives (mean and standard deviation) of children’s socio-demographics, motor competence (i.e., locomotion, object control & FMS) and children’s, parents’ and teachers’ perception of children’s motor competence.

<table>
<thead>
<tr>
<th></th>
<th>Main sample (n = 139) age 6-11 years</th>
<th>Subsample (n = 67) age 6-8 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Children’s MC&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Children’s perception</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Age (years)</td>
<td>8.16</td>
<td>1.37</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.31</td>
<td>0.12</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>31.89</td>
<td>10.49</td>
</tr>
<tr>
<td>BMI percentile</td>
<td>67.81</td>
<td>29.23</td>
</tr>
<tr>
<td>Locomotion</td>
<td>33.88</td>
<td>5.19</td>
</tr>
<tr>
<td>Object Control</td>
<td>37.27</td>
<td>6.93</td>
</tr>
<tr>
<td>FMS</td>
<td>71.14</td>
<td>10.41</td>
</tr>
</tbody>
</table>

MC = motor competence. <sup>a</sup> = 72 boys from the main sample. <sup>b</sup> = 34 boys from the subsample. Children’s, parents’ and PE teachers’ perception = equivalent perception of children’s motor competence. BMI = body mass composition adjusted by age and sex; FMS = fundamental movement skills.
Table 2

Internal consistency using ordinal alpha and Spearman’s correlation (rho) between children’s motor competence (i.e., locomotion, object control & FMS) and children, parents and teachers’ perception of children’s motor competence.

<table>
<thead>
<tr>
<th>Perception</th>
<th>Ordinal alpha</th>
<th>Main sample (n = 139)</th>
<th>Subsample (n = 67)</th>
<th>Actual Skill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child</td>
<td></td>
<td>Locomotion</td>
<td>Object Control</td>
<td>FMS</td>
</tr>
<tr>
<td>Locomotion</td>
<td>.61</td>
<td>.66</td>
<td>-.04</td>
<td></td>
</tr>
<tr>
<td>Object Control</td>
<td>.66</td>
<td>.68</td>
<td>.11</td>
<td></td>
</tr>
<tr>
<td>FMS</td>
<td>.70</td>
<td>.74</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Parent</td>
<td></td>
<td>Locomotion</td>
<td>Object Control</td>
<td>FMS</td>
</tr>
<tr>
<td>Locomotion</td>
<td>.87</td>
<td>.87</td>
<td>.17*</td>
<td></td>
</tr>
<tr>
<td>Object Control</td>
<td>.82</td>
<td>.82</td>
<td>.31**</td>
<td></td>
</tr>
<tr>
<td>FMS</td>
<td>.87</td>
<td>.86</td>
<td>.21*</td>
<td></td>
</tr>
<tr>
<td>PE Teacher</td>
<td></td>
<td>Locomotion</td>
<td>Object Control</td>
<td>FMS</td>
</tr>
<tr>
<td>Locomotion</td>
<td>.92</td>
<td>-</td>
<td>-.</td>
<td></td>
</tr>
<tr>
<td>Object Control</td>
<td>.89</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
FMS | 1 | .94 | - | .51**

Note. ¹unstandardised ordinal alpha for each subscale and the PMSC. FMS = fundamental movement skills. PE = physical education. * $p < .05$; ** $p < .01$
Table 3

Mixed effects models analyses for children’s perception of children’s motor competence predicting children’s actual motor competence.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Clusters</th>
<th>Adj. coeff</th>
<th>Robust SE</th>
<th>Z statistic</th>
<th>AIC</th>
<th></th>
<th>BIC</th>
<th>η² (5 df)</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Locomotion (outcome)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children perception</td>
<td>139</td>
<td>7</td>
<td>.40 [.12, .67]</td>
<td>.14</td>
<td>.005</td>
<td>819.27</td>
<td></td>
<td>839.81</td>
<td>.29 [.15, .39]</td>
<td>&lt; .0001</td>
<td></td>
</tr>
<tr>
<td>Children perception</td>
<td>67</td>
<td>4</td>
<td>.62 [.42, .82]</td>
<td>.10</td>
<td>&lt; .0001</td>
<td>390.93</td>
<td></td>
<td>406.37</td>
<td>.20 [.01, .32]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Object Control (outcome)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children perception</td>
<td>139</td>
<td>7</td>
<td>.34 [-.23, .90]</td>
<td>.29</td>
<td>.241</td>
<td>829.59</td>
<td></td>
<td>850.13</td>
<td>.58 [.45, .64]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children perception</td>
<td>67</td>
<td>4</td>
<td>.46 [-.58, 1.49]</td>
<td>.53</td>
<td>.387</td>
<td>422.33</td>
<td></td>
<td>437.76</td>
<td>.36 [.13, .48]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FMS (outcome)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children perception</td>
<td>139</td>
<td>7</td>
<td>.49 [-.01, .99]</td>
<td>.25</td>
<td>.053</td>
<td>960.22</td>
<td></td>
<td>980.76</td>
<td>.52 [.39, .60]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children perception</td>
<td>67</td>
<td>4</td>
<td>.68 [.09, 1.28]</td>
<td>.30</td>
<td>.024</td>
<td>473.13</td>
<td></td>
<td>488.57</td>
<td>.29 [.06, .40]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adj. coeff.= Adjusted unstandardized coefficients; robust SE = Robust standard error; CI = confidence interval; η² = Eta squared; df= degrees of freedom. Children perception = Children’s perceived motor competence. FMS = fundamental movement skills. All mixed effects models were adjusted for age, sex and ageXsex interaction. Note: ageXsex interaction terms are included in models even when not statistically significant (results not shown). AIC = Akaike’s information criterion. BIC = Bayesian information criterion (smaller AIC and BIC values suggest a better model). Clusters = number of teachers/classroom involved. η² represents the proportion of variation explained by the model from multiple linear regression models adjusted for ageXsex interaction term and teacher variable.
Table 4

Mixed effects models analyses for parents’ perception of children’s motor competence predicting children’s actual motor competence.

|                          | n  | Clusters | Adj. coeff 95% CI | Robust SE | Z statistic p-value | AIC || BIC | η² (5 df) 95% CI |
|--------------------------|----|----------|-------------------|-----------|---------------------|------|------|-----------------|
| **Locomotion (outcome)** |    |          |                   |           |                     |      |      |                 |
| Parents perception       | 139| 7        | .44 [.18, .70]    | .13       | **.001**            | 805.87|| 826.41| .36 [.21, .45]   |
| Parents perception       | 67 | 4        | .38 [.16, .60]    | .11       | **.001**            | 387.56|| 402.99| .24 [.03, .36]   |
| **Object Control (outcome)** |  |          |                   |           |                     |      |      |                 |
| Parents perception       | 139| 7        | .36 [.16, .55]    | .10       | <.0001              | 824.41|| 844.95| .59 [.47, .66]   |
| Parents perception       | 67 | 4        | .47 [.32, .61]    | .07       | <.0001              | 418.96|| 434.39| .39 [.16, .50]   |
| **FMS (outcome)**        |    |          |                   |           |                     |      |      |                 |
| Parents perception       | 139| 7        | .43 [.26, .60]    | .09       | <.0001              | 950.58|| 971.12| .56 [.43, .63]   |
| Parents perception       | 67 | 4        | .43 [.38, .47]    | .02       | <.0001              | 470.46|| 485.90| .31 [.08, .43]   |

Adj. coeff.= Adjusted unstandardized coefficients; robust SE = Robust standard error; CI = confidence interval; η² = Eta squared; df= degrees of freedom. Parents perception = Parents’ perceived motor competence. All mixed effects models were adjusted for age, sex and ageXsex interaction. Note: ageXsex interaction terms are included in models even when not statistically significant (results not shown). AIC = Akaike’s information criterion. BIC = Bayesian information criterion (smaller AIC and BIC values suggest a better model). Clusters = number of teachers/classroom involved. η² represents the proportion of variation explained by the model from multiple linear regression models adjusted for ageXsex interaction term and teacher variable.
Table 5

Mixed effects models analyses for PE teachers’ perception of children’s motor competence predicting children’s actual motor competence.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Perception</th>
<th>n</th>
<th>Clusters</th>
<th>Adj. coeff 95% CI</th>
<th>Robust SE</th>
<th>Z statistic</th>
<th>AIC</th>
<th>BIC</th>
<th>η² (5 df) 95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotion (outcome)</td>
<td>Teachers</td>
<td>67</td>
<td>4</td>
<td>.43 [.38, .47]</td>
<td>.02</td>
<td><strong>&lt; .0001</strong></td>
<td>387.21</td>
<td>402.65</td>
<td>.24 [.03, .36]</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>Object Control (outcome)</td>
<td>Teachers</td>
<td>67</td>
<td>4</td>
<td>.75 [.54, .95]</td>
<td>.10</td>
<td><strong>&lt; .0001</strong></td>
<td>409.34</td>
<td>424.77</td>
<td>.47 [.25, .57]</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>FMS (outcome)</td>
<td>Teachers</td>
<td>67</td>
<td>4</td>
<td>.58 [.46, .69]</td>
<td>.06</td>
<td><strong>&lt; .0001</strong></td>
<td>461.87</td>
<td>477.30</td>
<td>.39 [.16, .50]</td>
<td>&lt; .0001</td>
</tr>
</tbody>
</table>

Adj. coeff.= Adjusted unstandardized coefficients; robust SE = Robust standard error; CI = confidence interval; η² = Eta squared; df= degrees of freedom. Teachers perception = Teacher’s perceived motor competence. All mixed effects models were adjusted for age, sex and ageXsex interaction. Note: ageXsex interaction terms are included in models even when not statistically significant (results not shown). AIC = Akaike's information criterion. BIC = Bayesian information criterion (smaller AIC and BIC values suggest a better model). Clusters = number of teachers/classroom involved η² represents the proportion of variation explained by the model from multiple linear regression models adjusted for ageXsex interaction term and teacher variable.
Figure legend

Figure 1. Example of the graphical description of two items in the pictorial scale of Perceived Movement Skill Competence.
Pretty good at the skill

Not very good at the skill

Jumping forward

Catching
Highlights

• Specific and aligned instruments to study perceived and actual MC should be used.

• Children seem to present limited ability to report their MC.

• Parents’ and PE Teachers’ proxy reports can be seen as good sources of information.