Relationship Between Actual and Perceived Locomotor and Ball Skills Competence Among Children: A Person-Centered Approach

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Abstract

This study examined whether profiles varying in actual and perceived locomotor and ball skill competencies would be identified and whether these profiles would differ in relation to children's characteristics. Participants were 127 (70 boys; 57 girls) French-speaking Canadian children (5-11 years). Actual and perceived motor competencies were respectively measured using the Test of Gross Motor Development – Third version and the pictorial scale of Perceived Movement Skill Competence. Latent profile analyses revealed four profiles: (1) *Non-Alignment: Devaluation* (children underestimated their slightly below average competencies; 17.9%); (2) *Non-Alignment: Overestimation* (children overestimated their slightly below average competencies; 24.7%); (3) *Non-Alignment: Underestimation* (children slightly underestimated their above average competencies; 24.9%); (4) *Alignment: Low Competence* (children displayed accurate but slightly below average competencies; 32.5%). Girls were more likely to correspond to profiles 1 and 4, older children and children more frequently involved in physical activity/sport practice were more likely to correspond to profile 3, and younger children were more likely to correspond to profile 2. These results emphasize the importance of considering the alignment between perceived and actual motor competencies. They also indicate that age and physical activity/sport practice were associated with higher competencies, whereas girls and younger children were associated with lower competencies.

Keywords: Motor skill competencies; objective motor skill competencies; perceived motor skill competencies, discrepancies.

Motor competence is defined as "the degree of skilled performance in a wide range of motor tasks as well as the movement quality, coordination, and control underlying a particular motor outcome" (De Meester et al., 2020, p. 2001). Stodden et al. (2008) hypothesized that the relationship between physical activity and actual motor competence would be mediated by children's perceptions of their motor competence. In a recent review of the research literature related to Stodden et al.'s (2008) proposition, Robinson et al. (2015) found evidence for a positive relation between actual and perceived motor competence but noted that this relation had been insufficiently tested. Robinson et al. (2015) also observed that studies had mainly focused on physical self-perceptions (a broader construct showing only a limited alignment with motor competencies), suggesting that future studies should focus more directly on perceived motor competence.

More recently, De Meester et al. (2020) conducted a meta-analytic review of studies examining actual and perceived motor competence (including physical self-perceptions) among youth and young adults. Their results revealed small but significant relations between actual and perceived overall motor competence (r = .25), locomotor competence (r = .19), object control competence (r = .22) and stability/balance competence (r = .21). However, De Meester et al.'s (2020) results also failed to demonstrate any moderating effects of age, sex, developmental status and type of measure used (physical self-perceptions vs. perceived motor competence) on the relations between actual and perceived motor competence. Although they proposed various hypotheses to explain the low strength of relations between actual and motor competence, these explanations mainly invoked the methodological limitations of the reviewed studies and the need to adopt designs better suited to the identification of possible moderators of these relations.

However, beyond these relatively generic statements, a core characteristic of the studies reviewed by De Meester et al.'s (2020) is that they all relied on variable-centered analyses (e.g., regressions, correlations, structural equation modeling). Despite their interest, variable-centered analyses remain limited by their reliance on an assumption of population homogeneity (e.g., Howard & Hoffman, 2018; Morin & Wang, 2016). This assumption implies that, for any analysis, a single set of averaged parameters is assumed to equally apply to all members of the population. Although variable centered analyses make it possible to study the role of a priori moderators, they ignore the possibility that these relations might in fact differ in strength and direction across different subpopulations of children, possibly as a result of other, unexpected, characteristics. For instance, a relatively low average correlation among two variables may in fact be the result of two co-existing subpopulations of children, one characterized by a strong positive correlation and one characterized by a strong negative correlation. More importantly, although observed characteristics (e.g., age, sex, etc.) could possibly be related to membership into these different subpopulations, these subpopulations might also simply be defined by these different relations irrespective of any observed characteristics of the children. Person-centered analyses (e.g., Howard & Hoffman, 2018; Morin & Wang, 2016) explicitly relax this assumption of population homogeneity to identify subpopulations of children characterized by qualitatively and quantitatively distinct configurations on the variables of interest (i.e., actual and perceived motor competence in the present situation). As such, the person-centered approach seems to be naturally suited to a more precise unpacking of the nature and possible variations in the relations between perceived and actual motor competence.

Actual and Perceived Motor Competence Among Children: A Person-Centered Approach

As suggested by De Meester et al., (2016), a person-centered approach enables the identification of subpopulations of individuals who share particular attributes or relations among attributes. To our knowledge, only three studies have adopted a person-centered approach (implemented via cluster analytic procedures) to examine the relations between actual and perceived motor competence among US (De Meester et al., 2016), Belgian (Bardid et al., 2016), and Spanish (Estevan et al. (2019a) children. De Meester et al. (2016) and Bardid et al. (2016) both identified profiles characterized by low levels of actual and perceived motor competencies (Low-Low; representing respectively 34.3% and 20.6% of their samples), by high levels of actual and perceived motor competencies (High-High; representing respectively 33.7% and 32.3% of their samples), and by low levels of actual motor competence and high levels of perceived motor competence (Low-High, representing respectively 32% and 29.7% of their samples). In addition, Bardid et al. (2016) also identified a profile characterized by high levels of actual motor competence and low levels of perceived motor competence (High-Low, 17.4%). The results from these studies also revealed that: (a) moderate to vigorous physical activity levels were significantly higher in the High-High cluster than in the other clusters (De Meester et al., 2016); (b) children's body mass index (BMI) was lower in the High-High cluster than in the Low-Low cluster (De Meester et al., 2016); (c) the number of boys and girls did not differ across clusters (Bardid et al., 2016; De Meester et al., 2016); (d) levels of autonomous motivation and global self-worth were lower in the Low-Low and High-Low clusters than in the Low-High and High-High clusters (Bardid et al., 2016).

Estevan et al. (2019a) relied on a more advanced set of clustering procedures applied to a more diverse set of indicators (i.e., including both actual physical fitness and actual motor competence), making their result harder to integrate with the previous ones. More precisely, Estevan et al. (2019a) identified four clusters (which did not change when age was also integrated to the model) displaying a: (1) Partial Alignment (25%), characterized by moderate levels of physical fitness, moderately high levels of actual motor competence, and moderate levels of perceived motor competence; (2) Alignment (similar to the previously described High-High cluster; 19.2%); (3) Non-Alignment (Low levels of physical fitness and actual motor competence -Moderate levels of perceived motor competence; 35.3%); and (4) Non-Alignment (Moderate levels of physical fitness and actual motor competence –Low levels of perceived motor competence; 20.5%). Estevan et al.'s (2019a) results further showed that: (a) children from the Alignment cluster were more active than those from the two Non-Alignment clusters; and (b) more children in the Alignment cluster presented a normal-weight (*vs* overweight-obesity) than in the other clusters. In a final set of analyses, Estevan et al. (2019a) sought to identify similar clusters separately for boys and girls. Five clusters of children were identified for boys (four of those clusters were non-aligned) and girls (three of those clusters were aligned).

Despite their interest, the results from these previous person-centered studies (Bardid et al., 2016; De Meester et al., 2016; Estevan et al., 2019a) need to be interpreted with caution for various reasons. Thus, as noted by Robinson et al. (2015) in relation to variable-centered studies, two-thirds of person-centered studies (Bardid et al., 2016; De Meester et al., 2016) focused on physical self-perceptions (i.e., the sport/athletic competence subscale of the revised version of the Self-Perception Profile for Children; Harter, 2012) rather than on perceived motor competence. This is unfortunate given that perceived motor competencies would present a higher level of alignment with actual motor competencies, and thus represent a stronger mediator for the effects of actual motor competence. Furthermore, a single study (Estevan et al., 2019a) relying on matched measures of actual (Third version of the Test of Gross Motor Development; Estevan et al., 2017; Ulrich, 2019) and perceived motor competence (Perceived Movement Skill Competence; Estevan et al., 2019b; Johnson et al., 2016). However, this study also incorporated a non-matched measure of physical fitness in their clustering algorithm, as well as a measure of age as part of a secondary analysis (rather than directly contrasting the age distribution of the identified clusters. It is thus impossible to clearly assess the extent to which their results were impacted by the inclusion of this additional measure.

Additionally, motor skills are generally divided into at least two categories (locomotor skills, and object control or ball skills), although a third category (stability skills) is also sometimes considered (De Meester et al., 2020). Unfortunately, none of the previous studies investigated how clusters differed as a function of the type of motor skills, making it hard to assess how well these results generalize across types of motor skills. De Meester et al. (2020) highlighted the need to consider the role played by age, BMI (or BMI-weight-categories), physical activity behavior, and sex in relation to children's likelihood of membership into the identified profiles. So far, a single person-centered study (Estevan et al., 2019a) has considered this role, but has done so while relying on a wide range of different methods (estimating profiles separately across sex; including age in the clustering algorithm, and contrasting the clusters as a function of BMI and physical activity behavior), making it very hard to contrast and integrate the results from these different analyses.

All of the previous person-centered studies relied on cluster analyses. Relative to model-based latent profile analyses (LPA), classical cluster analyses present multiple limitations that call for caution when interpreting their results (Magidson, & Vermunt, 2002; Morin & Wang, 2016). First, cluster analyses are known to be highly reactive to (i.e., their results are known to change, or be impacted by) the retained clustering algorithm, as well as to the distribution and measurement scales of the variables considered. This limitation is made more severe by the fact that cluster analyses are not accompanied by clear quantitative guidelines to guide the selection of the optimal solution. In contrast, LPA come with a variety of indicators designed to help guide the selection of the optimal solution, rely on model based maximum likelihood estimation, and are relatively robust to the incorporation of variables measured using different scales and distributions (Magidson, & Vermunt, 2002; Morin & Wang, 2016). Second, cluster analyses rely on the assumption that participants are assigned to a single cluster. In contrast, LPA seek to identify latent profiles representing prototypical subpopulations (rather than observed subgroups) into which all participants have a probability of membership (Morin & Wang, 2016). In plainer terms, rather than assuming a perfect correspondence between participants and the latent profiles, LPA assign each individual a probability of membership into all profiles based on their prototypical similarity, which represents a way to implement a correction of classification errors in the model (Morin et al., 2018). Finally, cluster analyses are unable to incorporate predictors and/or outcomes directly in the model, forcing them to rely on a suboptimal two-step process whereby cluster membership is saved to an external file and linked to covariates using more traditional analyses (e.g., MANCOVA in De Meester et al., 2016; multilevel regression in Bardid et al., 2016; Kruskal-Wallis and χ^2 in Estevan et al., 2019a). In contrast, being model-based, LPA make it possible to directly incorporate predictors and/or outcomes into the model, thus making it possible to assess these associations in a way that is corrected for classification errors (Morin & Wang, 2016; Morin et al., 2018). This is the approach taken in the present study.

Objectives of the present study

The main objective of the present study was to examine the various configurations, or profiles, taken by matched measures of actual and perceived locomotor and ball skills competence among different subpopulations of children through person-centered LPA. More specifically, our first objective was to examine whether different profiles varying in level (high vs. low) and accuracy (e.g., underestimation, overestimation, devaluation) of actual and perceived locomotor and ball skills competence would emerge in the present sample. Based on results from previous studies (Bardid et al., 2016; De Meester et al., 2016; Estevan et al., 2019a) we expected to identify three to four profiles of children characterized by different combination of levels and accuracy. Our second objective was to examine whether the identified profiles would differ from one another in relation to their age, BMI, physical activity/sport practice, and sex composition.

Method

Participants

A total of 127 (70 boys and 57 girls) French-speaking Canadian children aged between 5 to 11 years old (M_{age} = 7.40 years, SD_{age} = 1.67 years; M_{BMI} = 15.98 kg/m², SD_{BMI} = 2.23 kg/m²) participated in this study. Of those, 75.4% were involved in a physical activity or a sport outside of school. In addition, according to sex- and age-specific revised cut-off scores of BMI provided by the International Obesity Task Force (Cole & Lobstein, 2012): 73.4% were normal weight, 15.6% were underweight and 11% were overweight (including 1.8% of children with obesity).

Measures

Characteristics of the Child. Parents/legal representatives were asked to report their child's age (in years), sex (girls coded 0 and boys coded 1), stature (in meters), and mass (in kilograms). Stature and mass were used to estimate children's BMI (in kg/m²) = [Mass/(Stature²)]. Finally, parents/legal representatives were asked to report their children's weekly frequency of physical activity/sport practice outside of the school, based on questions specifically developed for this study: (1) "*Does your child practice a physical activity or a sport outside of school?*"; and (b) If yes, "*Overall, how many times per week does he/she practice this physical activity or sport outside of school?*".

Actual Motor Competence. A French adaptation of the TGMD-3 (Ulrich, 2019) was used to measure children's actual motor competence. This adaptation was developed using standardized translation back-translation procedures (Hambleton, 2005) involving two independent professional bilingual translators and four members of the research team. The TGMD-3 assessed children's competence in relation to 6 locomotor skills (i.e., run, gallop, hop, skip, horizontal jump, and slide) and 7 ball skills (i.e., two-hand strike, one-hand forehand, one-hand stationary dribble, two-hand catch, kick a stationary ball, overhand throw, and underhand throw). For each skill, scores can range from 0 to 6 (i.e., one hand stationary dribble, two-hand catch, skip), 0 to 8 (i.e., gallop, hop, one-hand forehand, horizontal jump, kick a stationary ball, overhand throw, run, slide, underhand throw), or 0 to 10 (i.e., two-hand strike). Higher raw scores indicate higher motor skills competence. In the present study, the: (a) McDonald's (1970) omega coefficients of composite reliability of actual locomotor (ω = .739) and ball skills (ω = .835) competencies were both acceptable (see Table S2 of the online supplements); and (b) interrater reliability (intraclass correlations) of the locomotor (.997) and ball skill (.996) competencies were both excellent.

Perceived Motor Competence. The French adaptation of the PMSC (Johnson et al., 2016; Maïano et al., in press), which is aligned with the TGMD-3, was used to measure children's perceived motor competence. This instrument includes 6 items measuring perceived locomotor skills competence and 7 items measuring perceived ball skills competence. These items cover the same skills as the TGMD-3. Children responded to each item using a two-step procedure. First, they are presented with two figures, one showing a boy or a girl demonstrating competency in the targeted skill, and the other showing a boy or a girl demonstrating a lack of competence in the skill. Children are asked to indicate the figure that is the most like them. Second, children choosing the first figure (competent) are asked if they are "really good at" (4) or "pretty good at" (3) the targeted skill, whereas children choosing the second figure (not competent) are asked if they are "sort of good at" (coded 2) or "not too good at" (coded 1) the targeted skill. In the present study, the McDonald's (1970) omega coefficients of composite reliability of the perceived locomotor (ω = .652) and ball skills (ω = .771) competencies were both acceptable (Table S3 of the online supplements).

Procedures

These children were recruited in four elementary schools located in the Canadian Province of Québec. Permission to conduct this research was granted by the research ethics committee of the first author's University, and by the school board of the participating elementary schools. A letter informed parents/legal representatives about the study and that participating children were eligible, at the end of the study, for a random draw of 20 gift certificates of $20 (CAD) each. This letter clarified that the children had to display a typical development. Children were not recruited for this study if they had a developmental delay, a neurological disorder, or a sensory or physical disability. This also excluded children who need to receive assistance to move. Interested parents/legal representatives were then asked to sign an informed consent form, before completing a questionnaire about their child. Consent forms and questionnaires were sent back to the research team using two separate prepaid envelopes. After parental/legal representative consent was obtained, the research team met participants in their school where study objectives and procedures were discussed. Verbal consent was then requested from each child to continue with their participation in the study.

PMSC and TGMD-3 testing was administered at the participants' school. Three research team members administered the PMSC first to individual children who were asked to point out their answer in a booklet with figures as the instructions were read aloud by the administrator team member. Each answer was recorded by the administrator on a separate scoring sheet. After this, the TGMD-3 was administered by two experienced research team members who had undergone prior training in TGMD-3 assessment using Ulrich's (2019) assessment protocol. To ensure a non-bias assessment, administrators were blinded to the conditions of coding (i.e., they had no prior information regarding participants' motor skills). Children were paired for this component of the assessment. Each skill was first demonstrated by one administrator, and children were asked to practice each skill once. Then, they performed their two official trials one after the other and were both independently and simultaneously coded live by the two administrators. Administrators then compared their assessments, and a final score for each performance criteria was attributed to the participant. It is this final score that has been used to estimated scores on the TGMD-3.

Data Analysis

Analyses were conducted using Mplus 8.4 (Muthén & Muthén, 2019). Preliminary analyses were first realized to verify the psychometric properties of our measures using confirmatory factor analyses estimated using the robust weighted least squares estimator (WLSMV) to account for the ordinal nature of the rating scales used in this study (Finney & DiStefano, 2013). The few missing responses at the item level on the PMSC (.79%-1.57%, M = .85%) and the TGMD-3 (0.76%; M = 0.06%) were handled using algorithms implemented in Mplus in conjunction with the WLSMV estimator (Asparouhov & Muthén, 2010). The results from these preliminary measurement models are reported in Tables S1 (Model fit), S2 (TGMD-3) and S3 (PMSC) of the online supplements, and used to generate factor scores for our main analyses. These factor scores (when compared to observed scale scores) have the advantage of preserving the characteristics of the measurement model and provide a partial correction for measurement errors (Morin et al., 2017; Skrondal & Laake, 2001). Furthermore, these factor scores were estimated to have a mean of 0 and a standard deviation of 1, allowing us to interpret the results in standardized measurement units.

LPA were then estimated based on the four factor scores (perceived locomotor skills, perceived ball skills, actual locomotor skills, and actual ball skills) obtained in these preliminary analyses using Mplus' robust maximum likelihood estimator (MLR). These models were estimated using 10,000 random starts, 1000 iterations for the random starts, and the 500 best starts values were retained for final stage of optimization. Models including 1 to 8 profiles were estimated while allowing the mean of the four factor scores to be freely estimated across profiles, but constraining their variance to be equal across profiles, corresponding to the Mplus default estimation procedure. Despite the advantages associated with the free estimation of the variance across profiles (Morin et al., 2011), models based on this more flexible parameterization failed to converge on proper solutions (e.g., nonconvergence, impossible parameter estimates), suggesting overparameterization and thus supporting the value of our more parsimonious specification (Diallo et al., 2016).

To select the optimal number of profiles, one first has to consider the theoretical meaning, heuristic value, and statistical adequacy of each solution, while also considering the information provided by a variety of statistical indicators (Morin & Litalien, 2019; Morin & Wang, 2016). More precisely, lower values on the Akaike Information Criterion (AIC), consistent AIC (CAIC), Bayesian Information Criterion (BIC), and sample-size adjusted BIC (ABIC) indicate a better fitting model. Furthermore, a statistically significant p-value associated with the Lo-Mendell-Rubin likelihood ratio test (LMR; Lo et al., 2001) and with the bootstrap likelihood ratio test (BLRT) supports the superiority of a model relative to an alternative model including one fewer profile. A statistical simulation study conducted by Diallo et al. (2017) suggests that the BIC and CAIC should be favored when the model entropy (an indicator of classification accuracy ranging from 0 to 1) is high (e.g., ≥ .70 or .80), whereas the ABIC and BLRT should be preferred when it is low (e.g., ≤.60 or .50). However, all of these indicators remain sample size dependent (Marsh et al., 2009) and may thus keep on suggesting the addition of profile past the optimal solution. For this reason, it is also recommended to graphically display scores on the information criterion using an "elbow plot", which can be used to suggest the optimal solution based on the point at which the decreases in these scores reaches a plateau (Morin & Litalien, 2019; Morin et al., 2011). Once the optimal solution has been selected, the retained profiles were then compared in relation to children's age, BMI, sex, and week frequency of physical activity/sport practice using a model-based approached developed by Lanza et al. (2013) and implemented via Mplus's AUXILIARY (DCON) function (Asparouhov & Muthén, 2014).

Results

The results from the alternative LPA solutions are reported in Table 1, and the accompanying elbow plot is reported in Figure 1. Given the high entropy values, the BIC and CAIC should be favored relative to the alternative solution. These results show that the AIC, ABIC, and BLRT fail to converge on any specific solution, that the CAIC and LMR both support a 4-profile solution, and that the BIC supports a 6-profile solution but seems to reach a plateau around 4-profiles. On this basis, we more systematically examined solutions including 3 to 6 profiles. This examination revealed that adding a fourth profile resulted in the addition of a meaningful profile to the solution, whereas adding a fifth or sixth profile did not and simply resulted in the arbitrary division of an existing profile into smaller ones differing in level but not in shape. Therefore, the four profiles solution was retained.

The results from this solution are reported in Figure 2. The first profile characterizes 17.9% of the sample presenting strongly below average levels[1] of perceived ball skills and locomotor skills but only slightly below average actual levels of ball skills and locomotor skills. This profile presents a *Non-Alignment: Devaluation* configuration. The second profile (24.7%) was characterized by above average levels of perceived ball skills and locomotor skills accompanied by slightly below average levels of actual ball skills and locomotor skills. This profile presents a *Non-Alignment: Overestimation* configuration. The third profile characterizes 24.9% of the sample presenting slightly above average levels of perceived ball skills and locomotor skills, coupled with above average levels of actual ball skills and locomotor skills. This profile presents a *Non-Alignment: Underestimation* configuration. Finally, the fourth profile (32.5%) was characterized by slightly below average levels of perceived ball skills and locomotor skills accompanied by matching (slightly under average) levels of actual ball skills and locomotor skills. This profile presents an *Alignment: Low Competence* configuration.

Profile Membership and Children's Characteristics

The results of the profile comparisons based on children's characteristics are reported in Table 2. First, these results showed that children corresponding to the *Non-Alignment: Devaluation* (Profile 1), *Non-Alignment: Underestimation* (Profile 3) and *Alignment: Low Competence* (Profile 4) profiles were older than those corresponding to the *Non-Alignment: Overestimation* (Profile 2) profile. Children corresponding to the *Non-Alignment: Underestimation* (3) were also older than those corresponding to the *Alignment: Low Competence* (4) profile. Second, the results indicated that the proportion of girls was higher in the *Non-Alignment: Devaluation* (1: 72.6%) and *Alignment: Low Competence* (4: 56.2%) profile than in the *Non-Alignment: Overestimation* (2: 29.4%) and *Non-Alignment: Underestimation* (3: 23.9%) profiles. Third, the results revealed that children corresponding to the *Non-Alignment: Underestimation* (3) profile were involved in a higher weekly frequency of physical activity/sport practice than those corresponding to the remaining profiles. Finally, the results revealed no differences between the profiles as a function of children's BMI levels.

Discussion

This study sought to identify the various configurations, or profiles, taken by matched measures of actual and perceived locomotor skill and ball skill competencies among children, and to verify how these profiles would differ from one another on the basis of children's characteristics. Matching the results from previous person-centered studies relying on cluster analyses (Bardid et al., 2016; De Meester et al., 2016; Estevan et al., 2019a), the present LPA results led to the identification of four well-differentiated profiles of children. However, and contrasting with the results from some of these previous studies (Bardid et al., 2016; De Meester et al., 2016), the present results (as well as those obtained by Estevan et al., 2019a) suggest that the observed configurations of locomotor skill and ball skill competencies are indicative of a relatively important level of misalignment for a majority of children (67.5% in this study, and 80.8% in Estevan et al., 2019a). Furthermore, and contrasting with all of these previous studies, none of the identified profiles was characterized by high and aligned levels of perceived and actual motor skill competencies. Indeed, in the present study, a single profile was characterized by aligned, but low, levels of perceived and actual motor skill competencies. Likewise, none of the profiles identified in the present study evidenced differences related to the type of motor skills considered (i.e., locomotor skills or ball skills), which might be explained by the moderately high correlations observed between both of these constructs (r >. 600; see Tables S2-S3 in online supplements). However, irrespective of these correlations, these results suggest that, at least in this age group, competencies related to different types of motor skills seem to be perfectly aligned for most children, suggesting that global measures of motor skills might be sufficient to capture children's actual and perceived competencies.

The results related to the *Non-Alignment: Devaluation* (1) and *Alignment: Low Competence* (4) profiles are generally consistent with *Low-Low* (Bardid et al., 2016; De Meester et al., 2016), and *Non-Alignment: Moderate-Low* (Estevan et al., 2019a) clusters identified in previous studies. More specifically, they indicate that roughly half of the sample presented low levels of actual and perceived motor competencies (which is also consistent with the results reported by De Meester et al., 2016), and that many of those children (roughly one third of the total sample) perceived their motor skill competencies to be worse than they actually are. Subsequent analyses revealed that the *Non-Alignment: Devaluation* and *Alignment: Low Competence* profiles included significantly more girls (72.6% and 56.2%) than the *Non-Alignment: Overestimation* and *Non-Alignment: Underestimation* profiles. These results are consistent with previous variable-centered studies (for reviews see Barnett et al., 2016; De Meester et al., 2020; Nobre & Valentini, 2019) showing that girls tended to score significantly lower than boys on actual and perceived motor skill competencies. Although these results differ from the results reported by De Meester et al. (2016) and Bardid et al. (2016) in which no sex-related differences were found between the profiles, they are consistent with those reported by Estevan et al. (2019a).

It is worrisome to observe that half of the children (50.4%) were found to present low levels of perceived and actual motor competencies, and that girls seemed to be over-represented in these less competent profiles. Indeed, as noted by Stodden et al. (2008) these children may be "drawn into a negative spiral of disengagement" (p. 296), leading them to progressively neglect their motor skills to the benefits of other types of skills and activities. More specifically, they may become less autonomously motivated to participate in physical activities (Bardid et al., 2016; De Meester et al., 2020; Estevan et al., 2019a), leading to longer term negative consequences in terms of health and fitness. Clearly, it would seem important for future research to examine the extent to which the present sex differences would be replicated within new samples of children, and to more specifically examine the mechanisms at play in explaining these preoccupying sex-differences.

Contrasting with these two less competent profiles, the remaining half of the sample displayed profiles with slightly below average to above average levels of actual motor skills competencies, accompanied by slightly above average to above average perceived levels of motor skill competencies. Interestingly, none of these profiles displayed aligned levels of perceived and actual motor skill competencies, and both profiles included a greater proportion of boys than the remaining profiles (> to 70% in both profiles). Furthermore, one of these profiles seemed to underestimate their above average levels of actual motor skills competencies (Profile 3: *Non-Alignment: Underestimation*; 24.9% of the sample), whereas the other seemed to overestimate their slightly below average levels of actual motor skills competencies (Profile 2: *Non-Alignment: Overestimation*; 24.7%).

The first of those profiles (*Non-Alignment: Underestimation*) included older (M = 8.21 years) children involved in a higher frequency of physical activity/sport practice (M = 2.29 days/week). These results are consistent with those found in previous person-centered studies (De Meester et al., 2016; Estevan et al., 2019a) showing that older children and children involved in more frequent physical activity/sport tend to display higher levels of actual and perceived motor skill competencies. These results also support Stodden et al.'s (2008) hypothesis that higher levels of actual and perceived motor competence should be intimately related to youth's levels of involvement in physical activity. However, and despite their relatively high actual levels of motor skill competencies, these children still tend to underestimate these competencies. This observation might be partly explained by an age-related shift in the types of sources of information used to assess their motor competencies (Horn, 2004; Horn & Amorose, 1998; Nobre & Valentini, 2019; Weiss & Amorose, 2005). Thus, during the late childhood period (8-10 years), parental/coach feedback, performance and peer comparisons tend to become more salient sources of information to guide self-evaluations (Horn, 2004; Horn & Amorose, 1998; Nobre & Valentini, 2019; Weiss & Amorose, 2005). Importantly, as these children also tend to display a higher frequency of involvement in physical activities, these alternative sources of social comparisons might have become more accessible for these children than for their peers exposed to less frequent sources of external feedback (Marsh & Cheng, 2012).

In contrast, in the second of those profiles (*Non-Alignment: Overestimation*), children over-estimated their slightly below average levels of actual motor skills competencies. This profile is consistent with a profile reported in previous person-centered studies (De Meester et al., 2016; Bardid et al., 2016; Estevan et al., 2019a). The age (i.e., including the youngest participants with M = 6.33 years) composition of this profile might possibly explain, in part, the overestimation tendencies associated with this profile. Indeed, younger children (5 to 7 years) tend to place more emphasis on task mastery rather than on performance and peer comparisons to assess their own motor skill competencies, which tend to make them more likely than older children to over-estimate their motor competencies (De Meester et al., 2020; Nobre & Valentini, 2019; Stodden et al., 2008; Weiss & Amorose, 2005). Nevertheless, as mentioned by Stodden et al. (2008), at this age, inflated perceptions of "[…] motor skill competence might be valuable to drive the acquisition of motor skill competence because children will continue to persist and engage in mastery attempts in activities in which they believe they are skillful." (p. 296).

Despite the interest of our results, the present study has several limitations that should be considered in their interpretation. First, we relied on a relatively small (N = 127) convenience sample of children mainly composed of normal weight children (73.4%) involved in physical activity/sport outside of school (75.4%). Therefore, the extent to which these results would generalize to a larger and more representative (i.e., including more children not involved in physical activity/sport outside of the school and more underweight, overweight or obese children) sample remains unknown. Second, physical activity/sport practice was measured by a single item (reported by parents) that has never been psychometrically validated. Therefore, our results can be considered to be less accurate in relation to physical activity/sport practice than those reported in previous centered studies that rely on objective (i.e., by accelerometers; Bardid et al., 2016; De Meester et al., 2016) or validated self-reported questionnaires (Estevan et al., 2019a). In addition, the present measure of physical activity/sport practice generically refers to any type of practice occurring outside of the school setting. It is thus possible that our measure might have underestimated (due to the neglect of school-based practice) or overestimated (due to parents' positive perceptions of their children) children's levels of involvement, and/or that they might have differed across different types of activities. Importantly, information regarding the duration, or intensity, of children's weekly sessions of involvement in physical activity and sport practice is also lacking. Therefore, it is thus important to consider replicating the present results using validated, and more comprehensive, measures of physical activity/sport practice encompassing multiple contexts (i.e., school, home, weekdays, weekend), activities, and a combination of informant (e.g., self, parents, etc.) and objective (e.g., accelerometer) measures.

Third, actual motor competencies (TGMD-3) were assessed using a process-oriented test scoring approach (i.e., measuring how the skill is executed or performed). Relative to a product-oriented test (i.e., measuring the results or the performance at the test), the reliance on a process-oriented assessment might have led to an increase in the degree of accuracy observed between actual and perceived motor skill competencies (i.e., children might have anchored their self-perceptions in their capacity to execute the task with success, rather than to their ability to execute the task with mastery). It would be interesting for future research to consider how children's profiles might differ across these two types of measures of actual motor skill competencies. Finally, the small sample size of children used in the present study made it impossible to examine the extent to which these profiles would remain unchanged as a function of children's characteristics (e.g., sex, age, etc.). Likewise, the cross-sectional design of the present study made it impossible to assess the similarity of the identified profiles over time, as well as the stability of children's membership into each of these profiles over time. It would be interesting for future research to rely on a longitudinal framework to more specifically consider profile stability, and its determinants and outcomes, over time.

In conclusion, the present result support the identification of four profiles of children varying in their level of actual and perceived motor skills competencies, and in the degree to which their perceived and actual motor skills competencies are aligned with one another. These results are consistent with previous variable-centered and person-centered studies and confirm that: (a) younger children tend to over-estimate their motor skill competencies; (b) older children and children involved in higher frequencies of physical activity/sport tend to demonstrate higher levels in actual and perceived motor skill competencies; and (c) girls are more likely to display a profile characterized by lower levels of actual and perceived motor skill competencies than boys. In addition, our results also revealed that underestimation of one's own motor skill competencies was far more frequent than the overestimation of these competencies, and could occur both at the lowest (*Non-Alignment: Devaluation*), and at the highest (*Non-Alignment: Underestimation*), level of the spectrum, whereas over-estimation only occurred when actual motor skill competencies were slightly below average (*Non-Alignment: Overestimation*). Finally, the present results showed that physical education or sport interventions should devote more attention to the degree of alignment between children's actual and perceived motor competencies, as well as on children's overall profiles of actual and perceived competencies as these profiles seem to be associated with their frequency of involvement in physical activity/sport practice. In addition, physical educators and instructors should be particularly attentive to the actual and perceived motor competencies of girls and younger children, as these more frequently display less desirable profiles, respectively characterized by a tendency to devaluate (girls) or to overestimate (younger children) themselves.

Footnote

[1] A score of zero corresponds to the sample average and scores are expressed in standard deviation units. Therefore, we consider scores between: (a) +0.10 and + 0.50 or -0.10 and - 0.50 to be slightly above or slightly below the average; (b) +0.51 and +1 or -0.51 and -1 to be above or below the average; and (c) ≥ +1.01 or -1.01 to be strongly above or strongly below the average.

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Table 1

Results from the Latent Profile Analyses

Model	LL	#fp	Scaling	AIC	CAIC	BIC	ABIC	Entropy	LMR	BLRT
1 profile	-624.646	8	.8543	1265.292	1296.045	1288.045	1262.746	NA	NA	NA
2 profiles	-563.440	13	1.0684	1152.880	1202.854	1189.854	1148.742	.799	≤ .001	≤ .001
3 profiles	-532.930	18	1.1101	1101.866	1171.062	1153.062	1096.138	.849	.032	≤ .001
4 profiles	-512.586	23	1.0843	1071.171	1159.588	1136.588	1063.852	.845	.046	≤ .001
5 profiles	-498.477	28	1.0709	1052.954	1160.591	1132.591	1044.043	.863	.098	≤ .001
6 profiles	-480.210	33	1.0790	1026.419	1153.277	1120.277	1015.917	.880	.164	≤ .001
7 profiles	-469.109	38	1.0278	1014.218	1160.297	1122.297	1002.125	.885	.119	≤ .001
8 profiles	-455.710	43	1.1735	996.143	1161.443	1118.443	982.458	.892	.543	≤ .001

Notes. LL: Model log-likelihood; #fp: Number of free parameters; Scaling: Scaling factor associated with model; AIC: Akaike Information Criterion; CAIC: Consistent AIC; BIC: Bayesian Information Criterion; ABIC: Sample size adjusted BIC; LMR: Lo-Mendell-Rubin likelihood ratio test; BLRT: Bootstrap Likelihood Ratio Test.

Table 2

Differences Between Profiles as Function of Children's Characteristics

Profiles	Age Mean (SE)	Significant differences	Sex Mean (SE)	Significant differences	Body-mass index Mean (SE)	Significant differences	Frequency of PA/SP Mean (SE)	Significant differences
1	7.987 (.345)	1 = 3; 1 = 4; 1 > 2; 3 > 4 > 2	.274 (.093)	2 = 3 > 1 = 4	16.145 (.568)	1 = 2 = 3 = 4	1.225 (.245)	3 > 1 = 2 = 4
2	6.327 (.209)		.706 (.082)		15.750 (.405)		1.156 (.190)	
3	8.207 (.288)		.761 (.077)		15.992 (.406)		2.291 (.286)	
4	7.340 (.247)		.438 (.076)		16.070 (.378)		1.200 (.170)	

Notes. SE: standard error; PA: physical activity; SP: sport practice; Age is coded in years; Sex is coded 0 for girls and 1 for boys; Body-mass index is coded in kg/m² and frequency of PA/SP is coded in days (0 to 7).

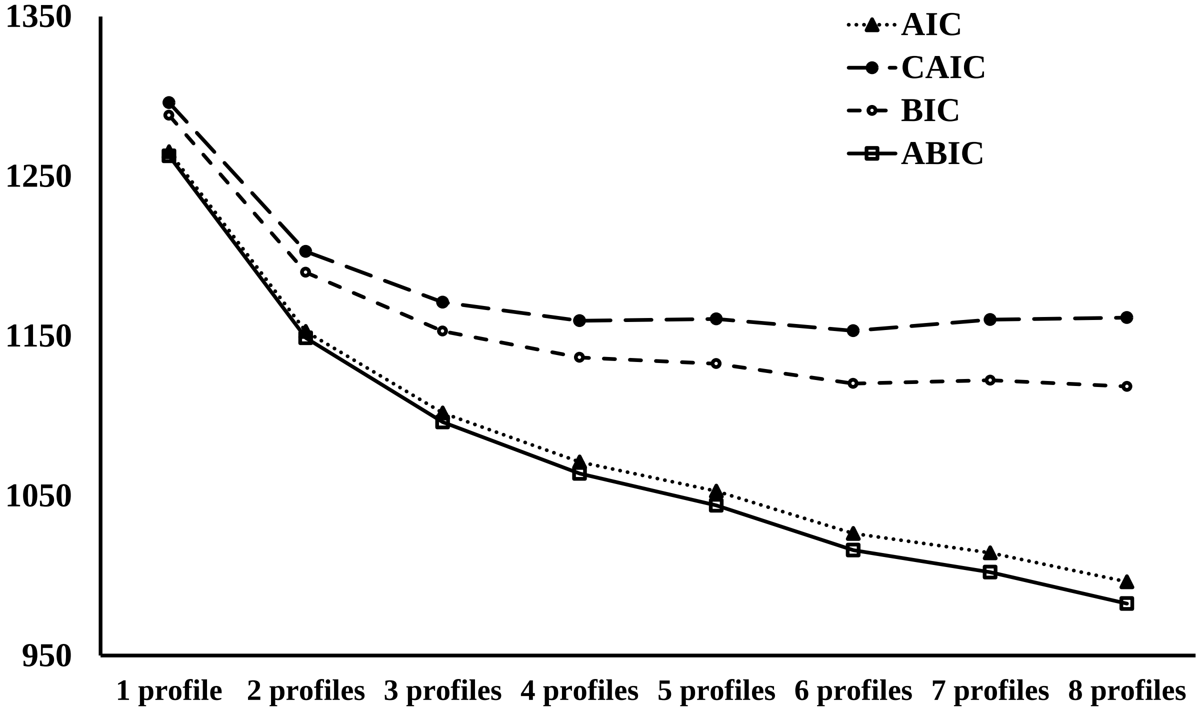

Figure 1. *Elbow Plot of the Information Criteria for the Latent Profile Analyses*
Notes. AIC: Akaike Information Criterion; CAIC: Consistent AIC; BIC: Bayesian Information Criterion; ABIC: Sample size adjusted BIC.

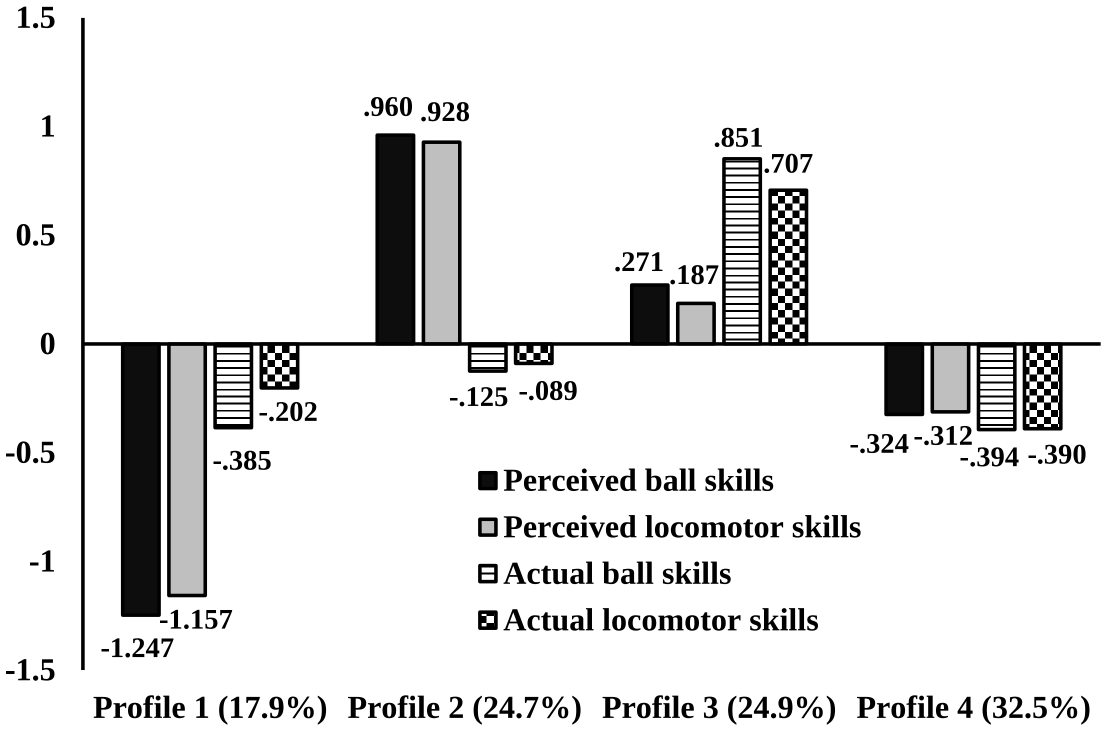

Figure 2. *Within-Profile Means for the Latent Profile Analyses Solution*
Note. Profile indicators are factor scores estimated in standardized units (M = 0; SD = 1).

Online Supplements for:

Relationship Between Aligned Actual and Perceived Locomotor and Ball Skills Competence Among Children: A Person-Centered Approach

Table S1. *Goodness-of-Fit Statistics of Two-Factor CFA for the TGMD-3 and PMSC*

Table S2. *Standardized Parameters Estimates from the Two-Factor Solution of the TGMD-3*

Table S3. *Standardized Parameters Estimates from the Two-Factor Solution of the PMSC*

Table S1

Goodness-of-Fit Statistics of Two-Factor CFA for the TGMD-3 and PMSC

Measures	$W\chi^2$ (df)	CFI	TLI	RMSEA	RMSEA 90% CI
TGMD-3	112.698(64)*	.925	.908	.077	.053-.101
PMSC	76.793(64)	.959	.950	.040	.000-.070

Notes. * $p < .01$; $W\chi^2$: Robust weighed least square (WLSMV) chi-square; df: Degrees of freedom; CFI: Comparative fit index; TLI: Tucker-Lewis index; RMSEA: Root mean square error of approximation; 90% CI: 90% confidence interval of the RMSEA; TGMD-3: Test of Gross Motor Development - Third version; PMSC: Pictorial Scale of Perceived Movement Skill Competence for Young Children.

Table S2

Standardized Parameters Estimates from the Two-Factor Solution of the TGMD-3

Skills	Actual Ball Skills (λ)	Actual Locomotor Skills (λ)	δ
Two-hand strike of a stationary ball	.719		.483
One-hand forehand strike of self-bounced ball	.670		.551
One hand stationary dribble	.649		.578
Two-hand catch	.572		.672
Kick a stationary ball	.578		.666
Overhand throw	.676		.543
Underhand throw	.668		.553
Run		.681	.536
Gallop		.588	.654
Hop		.547	.701
Skip		.453	.795
Horizontal jump		.447	.800
Slide		.667	.555
ω	.835	.739	
Latent Factor Correlation	.616		

Notes. All coefficients are statistically significant ($p \leq .05$); TGMD-3: Test of Gross Motor Development - Third version; λ: Factor loading; δ: Uniqueness; ω: Omega coefficient of composite reliability.

Table S3

Standardized Parameters Estimates from the Two-Factor Solution of the PMSC

Items	Perceived Ball Skills (λ)	Perceived Locomotor Skills (λ)	δ
Hitting a ball	.564		.682
Hitting one hand	.450		.797
Bouncing	.573		.672
Catching	.559		.687
Kicking	.517		.733
Throwing underhand	.514		.735
Throwing overhand	.791		.374
Running		.808	.348
Galoping		.316	.900
Hopping		.383	.854
Skipping		.383	.853
Jumping forwards		.535	.714
Sliding		.465	.783
ω	.771	.652	
Latent Factor Correlation	.768		

Notes. All coefficients are statistically significant ($p \leq .05$); PMSC: Pictorial Scale of Perceived Movement Skill Competence for Young Children; λ: Factor loading; δ: Uniqueness; ω: Omega coefficient of composite reliability.