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ARTICLE

A Variable- and Person-Centered Approach to Further Understand the Relationship Between Actual and Perceived Motor Competence in Children

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Purpose: To study the relationship between actual motor competence (AMC) and perceived motor competence (PMC) in a large sample of 6- to 12-year-old children. **Method**: The AMC and PMC were measured ($N = 1{,}669$, 55% boys) with the Athletic Skills Track and the Physical Self-Confidence Scale, respectively. A variable-centered approach was applied to examine the AMC–PMC association by means of correlation coefficients and Fisher's z tests. Cluster analyses were used to identify profiles of children from a person-centered perspective. **Results**: The AMC–PMC correlation strengthened with increasing age ($r = .084$ in 6- to 7-year-olds to $r = .416$ in 10- to 11-year-olds). The person-centered approach revealed two profiles with corresponding levels of AMC and PMC, and two profiles with divergent levels. **Discussion**: In addition to clarifying the age-related increase in the association between AMC and PMC, the profiles from the person-centered approach result in new gateways for tailoring interventions to the needs of children with different AMC–PMC profiles.

Keywords: cluster analyses, elementary school, motor skills, self-perception

Actual motor competence (AMC) refers to the degree of proficient performance in various motor skills as well as the underlying mechanisms such as motor control and coordination (Utesch & Bardid, 2019). In the last decade, many studies have investigated the association between AMC and a range of health outcomes. As such, across childhood and adolescence, AMC is known to be positively associated with a healthy weight status (D'Hondt et al., 2013), cardiorespiratory fitness (Cattuzzo et al., 2016), physical activity (Hulteen, Morgan, Barnett, Stodden, & Lubans, 2018; Logan, Webster, Getchell, Pfeiffer, & Robinson, 2015), and psychological benefits such as higher perceived motor competence (PMC) (Lubans, Morgan, Cliff, Barnett, & Okely, 2010). According to the conceptual model of Stodden et al. (2008), AMC is in constant interaction with PMC, which refers to a child's perception of his/her actual movement capabilities (Harter, 1999). Moreover, this model, which was revised by Robinson et al. (2015), states that children with higher AMC levels feel more competent than their lower skilled peers (Figure 1). Therefore, these children are more likely to engage in physical activity, leading to higher levels of health-related fitness, which will reduce the risk of developing an unhealthy weight status. Given the fact that both AMC and PMC are considered to be consistent predictors of physical activity levels (Babic et al., 2014; Robinson et al., 2015), it is crucial to not only implement strategies to improve AMC, but also to positively affect PMC.

The relationship between AMC and PMC has been investigated extensively over the last decades. A recent systematic review and meta-analysis of De Meester et al. (2020) reviewed 69 studies investigating the relationship between these two variables. However, most of the studies included in this meta-analysis relied on a variable-centered approach, which describes the general strength of the association between AMC and PMC in specific study samples. Yet, this approach does not provide insight into how different AMC and PMC may be combined at the individual level (Bardid et al., 2016). Accordingly, to examine whether children with similar AMC levels may differ in the degree to which they perceive themselves as motor competent, a person-centered approach is needed. Indeed, previous studies using this approach revealed different profiles of children (Bardid et al., 2016; Coppens et al., 2021; De Meester et al., 2016b; Estevan, García-Massó, Molina García, & Barnett, 2019; Weiss & Amorose, 2005), with some of them combining convergent levels of AMC and PMC

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(i.e., high[er] levels of AMC and high[er] levels of PMC or low[er] levels of AMC and low[er] levels of PMC), and others combining divergent levels of AMC and PMC (i.e., high[er] levels of AMC and low[er] levels of PMC, or vice versa). However, those studies recommended to use larger samples, which allow identifying more profiles and provide more clarity about differences among clusters (De Meester et al., 2016b).

The systematic review of De Meester et al. (2020) supported a positive relationship between AMC and PMC in children and adolescents, which was also hypothesized in the conceptual model of Stodden et al. (2008), indicating that higher AMC levels will lead to higher PMC levels. However, De Meester et al. (2020) reported generally low associations between these two constructs. The strength of the relationship between AMC and PMC may also relate to age since cross-sectional research on the topic demonstrated that this association strengthens with increasing age (Barnett, Morgan, van Beurden, & Beard, 2008). In general, in early childhood (2–5 years), PMC is not strongly correlated with AMC since young children often lack the cognitive capability to accurately estimate their AMC (Goodway & Rudisill, 1997; LeGear et al., 2012; Lopes, Barnett, & Rodrigues, 2016). As cognitive capabilities of children continue to develop in middle childhood (6–8 years) and late childhood (9–12 years), older children can estimate their own motor competence more accurately than younger children (Morano, Colella, & Capranica, 2011; Raudsepp & Liblik, 2002; Southall, Okely, & Steele, 2004). As such, a stronger correlation between AMC and PMC has been found in this older age group (Harter, 1999) in a variety of study samples (Barnett, Ridgers, & Salmon, 2015; Khodaverdi, Bahram, Stodden, & Kazemnejad, 2016; Raudsepp & Liblik, 2002; Vedul-Kjelsås, Sigmundsson, Stensdotter, & Haga, 2012). However, De Meester et al. (2020) did not find evidence supporting this strengthening association between AMC and PMC with increasing age. Though, it must be taken into account that the age effect in the meta-analysis was explored based on the mean ages of the included study samples. As the majority of studies comprised study samples with an age range covering several years, potential age effects could already have been leveled out within each sample, which could have covered the potential impact of age on the relationship between AMC and PMC. Therefore, a study in a large sample across different age groups might be helpful to further clarify the relationship between AMC and PMC.

Besides the inconsistent evidence of the influence of age on the relationship between AMC and PMC, the literature is inconclusive regarding the influence of gender either (De Meester et al., 2016b; 2020). Studies that examined the correlation between AMC and PMC for boys and girls separately found stronger correlations in girls than in boys (LeGear et al., 2012; Robinson, 2011). In addition, True, Brian, Goodway, and Stodden (2017) established that girls demonstrated stronger associations between process measures (i.e., quality measures) of AMC and PMC, while stronger associations between product measures (i.e., quantity measures) of AMC and PMC emerged in boys. Moreover, Rose, Larkin, and Berger (1997) assumed that for girls, AMC is associated with activities closely related to their perception of appearance while boys emphasize high performance in physical fitness, in relationship to body satisfaction and perception of appearance (Morano et al., 2011). The differences between boys and girls might also be explained by the differences in perception of AMC during developmental time. When it comes to PMC, a previous study showed that in younger boys and girls similar PMC levels were found (Crane, Naylor, Cook, & Temple, 2015). In addition, in late childhood, these results are less univocal since several studies showed higher PMC levels in favor of boys (Fredricks & Eccles, 2002; Noordstar, van der Net, Jak, Helders, & Jongmans, 2016; Rudisill, Mahar, & Meaney, 1993). Overall, the meta-analysis of De Meester et al. (2020) revealed that the strength of the relationship between AMC and PMC was not moderated by gender. However, some methodological issues should be taken into account since some included studies in the meta-analysis used raw AMC scores that were not adjusted for gender, while others used standardized scores. Second, for PMC, different types of questionnaires were used (i.e., unisex vs. boy or girl versions of questionnaires).

Considering these findings, investigating the relationship between AMC and PMC in a large sample across different age groups might further clarify the moderating role of gender and age in this relationship. Therefore, this study aims (a) to study the relationship between AMC and PMC in a large sample across different age groups and (b) to investigate to what extent gender- and age-related differences may emerge in this association, using a variable- and a person-centered approach.

Methods

Participants

For this study, 3,806 children from Grade 3 (6–7 years) to Grade 8 (11–12 years) were included from 21 different primary schools in The Netherlands. Eleven schools were located in the Hague region and 10 schools in the region of Arnhem and Nijmegen. In all schools, children from Grades 3–8 participated in at least two 45-min physical education (PE) lessons per week provided by a qualified teacher. All parents were informed about the current project by the schools prior to testing and gave permission for participation of their child(ren). This study was approved by the ethics committee of the HAN University of Applied Sciences (EACO 108.06/18). All measurements took place between October and November 2018. To be included in the analyses, a child had to complete both the AMC and PMC tests. As a result, 1,669 children (917 boys, 55%) were included. Table 1 shows background information about the participating children.

Procedure and Data Acquisition

Actual motor competence. The AMC was measured with the Athletic Skills Track (AST; Hoeboer, Krijger-Hombergen, Savelsbergh, & De Vries, 2018). The AST is a feasible assessment to measure motor competence in a PE setting (Klingberg, Schranz, Barnett, Booth, & Ferrar, 2019), and it makes it possible to accurately measure motor competence in a short amount of time (<1 min per child). The AST contains a series of five to seven fundamental motor tasks, which must be completed as quickly as possible. The raw outcome value is time in seconds (Hoeboer, Krijger-Hombergen, et al., 2018). In this study, Track 2 (AST-2) was used for 6- to 9-year-olds, and Track 3 (AST-3) was used for 9- to- 12-year-olds. In Track 2, the following skills had to be performed: walking, traveling jumps, hopscotch, alligator crawl backward, running backward, pencil roll, and clambering. Track 3 consists of the following: walking backward, traveling jumps, bunny hopping, alligator crawl backward, slaloming backward, forward roll, and clambering. The full test description can be found in the original paper of Hoeboer, Krijger-Hombergen, et al. (2018). In previous studies, the test–retest reliability of the AST was high

Table 1 Descriptive Statistics of Age, AMC and PMC by Grade, AST, and Gender, as Well as Correlations Between AMC and PMC Test per Grade and Gender

Grade	AST		Mean age (years)	*SD*	Number of children (*n*)	Mean AMC (MQ)	SD	Mean PMC (1–10)	SD	Spearman's rank correlation coefficient (AMC–PMC)	Fisher's *z* test Gender (*p*)	Fisher's *z* test Grade
Grade 3	AST-2	Total	6.60	0.38	255	94.12	17.75	8.06	1.30	.084	.06	Grades 3–4; .096 Grades 3–5; .049* Grades 3–6; < .001** Grades 3–7; < .001** Grades 3–8; .019*
		Girls	6.57	0.36	148	95.57	17.32	7.84	1.32	.019		
		Boys	6.65	0.40	107	92.10	18.21	8.36	1.22	.215*		
Grade 4	AST-2	Total	7.56	0.46	304	99.33	19.97	8.01	1.36	.193**	0.379	Grades 4–5; .341 Grades 4–6; .005** Grades 4–7; .001** Grades 4–8; .203
		Girls	7.53	0.42	152	101.26	20.45	7.79	1.34	.234**		
		Boys	7.59	0.49	152	97.40	19.35	8.24	1.35	.200*		
Grade 5	AST-2	Total	8.56	0.45	269	99.91	17.88	7.61	1.31	.226**	.25	Grades 5–6; .019* Grades 5–7; .006** Grades 5–8; .342
		Girls	8.58	0.49	152	100.59	16.21	7.45	1.32	.204*		
		Boys	8.55	0.41	117	99.02	19.87	7.83	1.28	.283**		
Grade 6	AST-3	Total	9.58	0.39	268	90.95	18.62	7.88	1.23	.389**	.294	Grades 6–7; .352 Grades 6–8; .046*
		Girls	9.52	0.38	133	90.33	19.04	7.82	1.27	.412**		
		Boys	9.64	0.39	135	91.55	18.25	7.94	1.20	.355**		
Grade 7	AST-3	Total	10.54	0.48	299	95.90	20.77	8.01	1.24	.416**	.141	Grades 7–8; .017*
		Girls	10.55	0.48	181	94.61	20.90	7.87	1.18	.347**		
		Boys	10.53	0.49	118	97.87	20.50	8.23	1.29	.455**		
Grade 8	AST-3	Total	11.54	0.45	274	102.96	19.50	7.98	1.17	.259**	.091	
		Girls	11.53	0.47	151	100.16	18.79	7.73	1.23	.181*		
		Boys	11.56	0.43	123	106.41	19.88	8.29	1.02	.334**		
Total		Total	9.09	1.73	1,669	97.26	19.55	7.93	1.28	.250**	.079	
		Girls	9.09	1.76	917	97.15	19.26	7.75	1.28	.221**		
		Boys	9.08	1.70	752	97.40	19.90	8.15	1.25	.286**		

Note. Fisher's z tests show the p values of the differences in strength of AMC–PMC correlations between gender and grade. AMC = actual motor competence; AST = Athletic Skills Track; MQ = motor quotient; PMC = perceived motor competence.
*Significant effect of $p < .05$. ** Significant effect of $p < .01$.

(AST-2: intraclass correlation coefficient = .802, 95% confidence interval [.717, .858] and AST-3: intraclass correlation coefficient = .800, 95% confidence interval [.669, .871]). The internal consistency of the AST was above the acceptable level of Cronbach's $\alpha \geq .70$ (Brown, Hume, & ChinAPaw, 2009) (AST-2: $\alpha = .700$ and AST-3: $\alpha = .763$), and there was a moderate to high inverse correlation between the time to complete the AST and the age- and gender-related motor quotients (MQ) of the Körperkoordinations Test für Kinder (i.e., a faster time relates to a higher MQ; AST-2: $r = -.646$, $p = .01$; and AST-3: $r = -.602$, $p = .01$; Hoeboer, Krijger-Hombergen, et al., 2018).

The AST was conducted during a regular PE lesson by a trained research assistant (i.e., students of a bachelor PE teacher education program). All research assistants were trained in conducting the test according to the protocol (i.e., setting up the track correctly and giving standardized instructions) during three meetings of 2 hr each. Each involved research assistant conducted the test in at least two schools. Prior to the measurement, the research assistant showed the participating children (divided in small groups of maximum 10 children) how to complete the track. After this demonstration, all children completed three tryout trials and received feedback from the research assistant before completing the test trial. Children wore light sports clothing and were barefooted during testing. Measurements took about 45 min per class with on average 30 children. To register the time in seconds (1 decimal) to complete the AST, a custom-made smartphone application with stopwatch function was used. Data were processed automatically and transferred into a secured and anonymized database.

Perceived motor competence. To measure PMC, the Physical Self-Confidence Scale (PSCS) was used (McGrane, Belton, Powell, Woods, & Issartel, 2016). McGrane et al. (2016) indicated the test–retest reliability for the scale as excellent, and the content validity and concurrent validity were also good among adolescents. Farmer, Belton, and O'Brien (2017) tested the PSCS for reliability in children of 8–12 years old and indicated this as very good. The PSCS contains 15 questions in which children rate their perceived competence in performing 15-specific skills using a Likert scale of 1–10, with "1" being *non competent at all* and "10" being *very competent*. For example: "How competent on a scale of 1–10 are you at the following skill?" Hop 3 times on each foot. Twelve of the items in the questionnaire were aligned with the skills assessed in the Test of Gross Motor Development—second edition (Ulrich, 2000) (i.e., run, leap, gallop, slide, horizontal jump, hop, catch, throw, roll, kick, strike, and stationary dribble), and three questions were based on additional skills from the Test of Gross Motor Development (Ulrich & Sanford, 1985) and the Victorian skills test (Walkley, Holland, Treloar, & O'Connor, 1996) (i.e., skip, balance and vertical jump). The children completed the PSCS online on a tablet during regular school lessons directly before or after the AMC test. The research assistant gave a brief explanation of all 15 items of the PSCS in groups of four or five children. Thereafter, the children completed the test individually.

Data Analysis

The time to complete the AST was used to calculate a MQ based on age- and gender-adjusted norm values (Hoeboer, Ongena, et al., 2018). The MQ was used as outcome measure for AMC. For PMC, the average score of the 15 items of the PSCS was taken as outcome measure (McGrane et al., 2016).

The relationship between AMC and PMC was examined by means of two different approaches: first, a variable-centered approach was applied to investigate the relationship between AMC and PMC for boys and girls separately and for various age groups. The Shapiro–Wilk's test showed that both variables did not demonstrate a normal distribution. Therefore, Spearman's rank correlation coefficients were used to examine the correlation between AMC and PMC. Correlation coefficients were interpreted as negligible: <.30; low: .30–.50; moderate: .50–.70; high: .70–.90; or very high: ≥.90 (Everitt, Landau, & Leese, 2001). Subsequently, Fisher's z tests with a 95% confidence level were used to explore if differences in correlations were statistically significant.

Second, a person-centered approach was used. Cluster analyses were conducted based on AMC and PMC scores to examine whether different profiles could be identified. Separate cluster analyses were conducted for each AST (Track 2 [age 6–9 years]/and Track 3 [age 9–12 years]). First, univariate outliers were removed (i.e., values more than three *SD*s below or above the mean). Next, a two-step procedure of hierarchical and nonhierarchical clustering methods was applied on AMC and PMC scores (Gore, 2000) and Ward's hierarchical clustering method was conducted to combine clusters based on similarity of squared Euclidean distance (Everitt et al., 2001). This analysis resulted in a three-, four-, and five-clustered solution for both ASTs. If the explained variance within a cluster solution was less than 50% for AMC and/or PMC, that specific cluster solution was eliminated for the following step (Milligan & Cooper, 1985). As a result, the three-cluster solutions for both tracks were eliminated (explained variance [Track 2: 48%; Track 3: 45%] < 50%). Cluster centers were used as nonrandom initial cluster centers in an iterative, nonhierarchical k-means clustering procedure (Asendorpf, Borkenau, Ostendorf, & Van Aken, 2001). After that, a double-split cross-validation procedure was conducted to explore the stability of the cluster solutions by randomly splitting the data set into halves and applying the two-step procedure of Ward and k-means in each subsample (Breckenridge, 2000). The children in the first half were again clustered based on their Euclidean distances to the cluster center of the other half. The new and original clusters were compared for agreement by means of Cohen's kappa. A Cohen's kappa of >.60 (good agreement) of the averaged two resulting kappa's was considered as acceptable (Asendorpf et al., 2001). To compare the distribution of boys and girls in the clusters, a chi-square test of independence was computed in the cluster solution in both age groups. In case of a significant interaction, contingency table analyses were conducted within each AST. All statistical analyses were performed using IBM SPSS statistics (version 24; IBM Corporation, Armonk, NY), and p values below .05 were considered statistically significant.

Results

Variable-Centered Approach

Table 1 shows the mean and *SD*s for AMC and PMC levels complemented with the Spearman's rank order correlations and Fisher's r to z tests between AMC and PMC for gender and age (grades). Regarding gender differences for each age group, Spearman correlations between AMC and PMC ranged from negligible ($r_s = .019$ [$p = .822$] for 6- to 7-year-old girls) to low ($r_s = .455$ [$p < .01$] for 10- to 11-year-old boys). When comparing the values by means of Fisher r to z transformation, the difference in strength between the correlation among boys and girls within the same age category was not significant (p values ranged from .379 to .06). When it comes to age, Spearman's correlations between AMC and

PMC increased in 6- to 11-year-olds, ranging from negligible ($r_s = .084$; $p = .18$) to low ($r_s = .416$; $p < .01$). However, the trend of a strengthening relationship between AMC and PMC with increasing age leveled off in the oldest age group ($r_s = .259$; $p < .01$). In addition, Fisher's z tests revealed significant differences among grades, which are presented in detail in Table 1. All coefficients were significant at a level of $p < .05$, except for the total group of children of age 6–7 years and for girls in this age group.

Person-Centered Approach

Cluster analyses showed that for both ASTs the kappa value was higher in the four-cluster solution compared with the five-cluster solution (AST-2: kappa: .859 vs. .702; AST-3: kappa: .874 vs. .662). Therefore, the four-cluster solution was used for further interpretation for both tracks. Figures 2 and 3 show the final four-cluster solutions for AST-2 and AST-3. For AST-2, 67% of the variance was explained by AMC and 61% by PMC, and for AST-3, 66% of the variance was explained by AMC and 67% by PMC. Four different motor competence-based clusters were identified in the data set (Figures 2 and 3; Tables 2 and 3). The clusters were labeled "high" versus "low," based on relative z scores (compared with the sample that completed the same track) for AMC and PMC, respectively, as described in the study of De Meester et al. (2016). Children in Cluster 1 (low-low; AST-2: $N = 179$; 21%/AST-3; $N = 169$; 20%) had, relative to children in the other clusters, low scores of AMC and low scores of PMC. Cluster 2 was labeled as low-high. Children in this cluster had, relatively to the other clusters, low scores on AMC and high scores on PMC (AST-2: $N = 277$; 32%/AST-3: $N = 290$; 35%). Children in Cluster 3 were labeled as high-low and had relatively high AMC and low PMC scores (AST-2: $N = 192$; 23%/AST-3: $N = 179$; 21%). Finally, Cluster 4 was labeled as high-high and comprised children with both a high AMC and PMC score (AST-2: $N = 206$; 24%/AST-3: $N = 198$; 24%) compared with their peers.

For AST-2 (6–9 years), 55% of the children fitted into a cluster with a divergent AMC–PMC level (i.e., high-low and low-high).

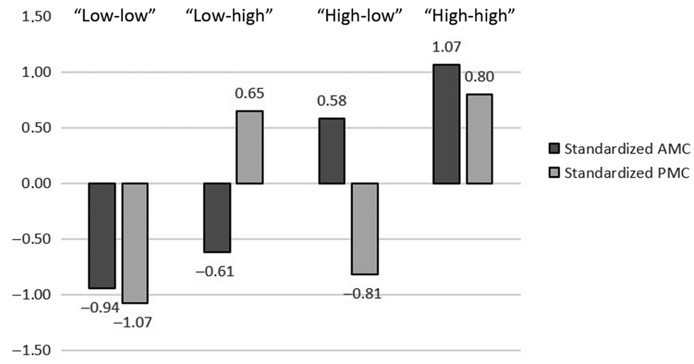

Figure 2 — Four-cluster solution for AST-2 (age 6–9 years) based on z scores for AMC and PMC. AST-2 = Athletic Skills Track 2; AMC = actual motor competence; PMC = perceived motor competence.

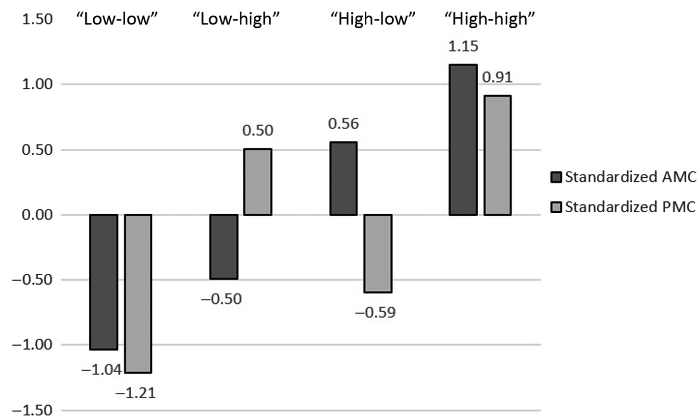

Figure 3 — Four-cluster solution for AST-3 (age 9–12 years) based on z scores for AMC and PMC. AST-3 = Athletic Skills Track 3; AMC = actual motor competence; PMC = perceived motor competence.

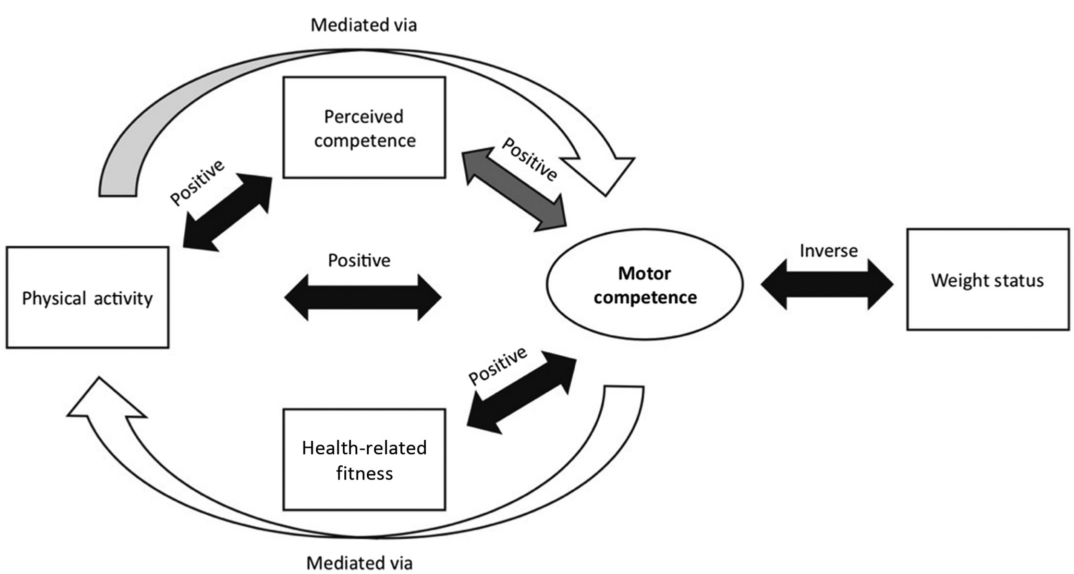

Figure 1 — Research consensus on motor competence and health-related variables. Black arrow indicates extensively tested: consistent relationship; dark gray arrow indicates moderately tested: variable relationship; partial gray arrow indicates partially tested: some evidence; white arrow indicates limited testing (Robinson et al., 2015).

Table 2 Mean Scores and Cluster Comparisons for the Four Clusters of AST-2 (Age 6–9 Years; *N* = 854)

AST-2 (age 6–9 years)	Cluster 1: Low-low	Cluster 2: Low-high*	Cluster 3: High-low	Cluster 4: High-high	*F*	η^2
n	179	277	192	206		
Boys/girls (*N*)	79/100	144/133	62/130	101/105		
AMC, mean (*SD*)	79.81 (9.60)[a]	85.94 (10.36)[b]	108.36 (10.72)[c]	117.49 (11.76)[d]	582.05	.67
PMC, mean (*SD*)	6.44 (0.86)[a]	8.78 (0.70)[c]	6.79 (0.84)[b]	8.97 (0.67)[c]	609.34	.68

Note. Values in parentheses are *SD*s. A cluster mean is significantly different from another mean if they have different superscripts. Differences between the four clusters were tested by means of post hoc analyses. AMC = actual motor competence; AST-2 = Athletic Skills Track 2; PMC = perceived motor competence.
*After significantly different can be stated ($P < .05$).

Table 3 Mean Scores and Cluster Comparisons for the Four Clusters of AST-3 (Age 9–12 Years; *N* = 836)

AST-3 (age 9–12 years)	Cluster 1: Low-low	Cluster 2: Low-high	Cluster 3: High-low	Cluster 4: High-high	*F*	η^2
n	169	290	179	198		
Boys/girls (*N*)	68/101	138/152	62/117	108/90		
AMC, mean (*SD*)	75.65 (11.41)[a]	86.58 (10.20)[b]	107.89 (10.94)[c]	119.90 (12.68)[d]	617.35	.69
PMC, mean (*SD*)	6.48 (0.77)[a]	8.57 (0.60)[c]	7.24 (0.72)[b]	9.07 (0.55)[d]	638.06	.70

Note. Values in parentheses are *SD*s. A cluster mean is significantly different from another mean if they have different superscripts. Differences between the four clusters were tested by means of post hoc analyses. AMC = actual motor competence; AST-3 = Athletic Skills Track 3; PMC = perceived motor competence.

Within these two clusters, the combined Pearson correlation between AMC and PMC was −.614 ($p \le .01$). The combined Pearson correlation for the aligned clusters (i.e., high-high and low-low) was .707 ($p \le .01$) in AST-2. When looking at AST-3 (9–12 years), 56% fitted in one of the two divergent clusters in which the combined Pearson correlation between AMC and PMC was −.496 ($p \le .01$). The combined Pearson correlation between AMC and PMC for the aligned clusters was .768 ($p \le .01$).

In each of the two age groups (i.e., age 6–9 years and age 9–12 years), a chi-square test of independence was computed to compare the cluster distribution in boys and in girls. A significant interaction was found in both groups (χ^2 [3] = 19.37, $p < .001$ and χ^2 [3] = 17.39, $p = .001$, respectively). To further examine this significant interaction effect, contingency table analyses were conducted revealing that the distribution of 6- to 9-year-old boys and girls in both the low-high profile (52% boys and 48% girls, $p = .0058$ compared with the Scheffé corrected *p* value of .0063) and the high-low profile (32% boys and 68% girls, $p < .0001$) was significantly different from the distribution in the overall sample of 6–9 years (45% boys and 55% girls) (Beasley & Schumacker, 1995). The distribution of 9- to 12-year-old boys and girls in the high-low profile (35% boys and 65% girls, $p = .0017$ compared with the Scheffé corrected *p* value of .0063) and in the high-high profile (55% boys and 45% girls, $p = .0019$) was significantly different from the distribution in the overall sample of 9–12 years (45% boys and 55% girls).

Discussion

The present study aimed to investigate the relationship between AMC and PMC in a large sample across different age groups. In addition, it was also examined whether the strength of the relationship between AMC and PMC differs between boys and girls in different age groups (i.e., 6–9 and 9–12 years).

Variable-Centered Approach

The variable-centered approach, which provides an overall picture of the average relationship between AMC and PMC, revealed a negligible to low correlation in the total sample. The same outcome held for each of the separate age groups (i.e., seven groups from age 6 to 12 years), with the exception of the age group of the 6- to 7-year-olds, in which the correlation between AMC and PMC was not significant. Furthermore, within each of those age groups, no significant gender-related differences in the strength of the correlation were found. These findings are in line with the meta-analysis of De Meester et al. (2020), revealing that the relationship between AMC and PMC was generally low, and not moderated by gender.

It is suggested in literature that the relationship between AMC and PMC strengthens with increasing age because the perceptions of children becomes stronger (Robinson et al., 2015; Stodden et al., 2008). Our results can partially confirm this hypothesis since a strengthening association between AMC and PMC was found from Grade 3 (6–7 years) to Grade 7 (10–11 years), which is in line with previous studies (Barnett et al., 2015; Khodaverdi et al., 2016; Raudsepp & Liblik, 2002; True et al., 2017; Vedul-Kjelsås et al., 2012). Interestingly, our results also indicate that the trend of a strengthening relationship between AMC and PMC with increasing age appears to level off in the oldest age group (i.e., 11- to 12-year-olds). This finding is in agreement with the large meta-analysis that did not confirm age to be a moderator of a strengthening relationship between AMC and PMC (De Meester et al., 2020). Previous studies also showed that younger children, in general, have a less accurate perception of their actual skills and tend to overestimate their abilities (Harter, 1999; True et al., 2017), which could be confirmed in the present study. One explanation might be that children's cognitive capabilities develop with increasing age, resulting in more accurate assessments of their own motor competence (Harter, 1999). Next to increased cognitive maturity, the gradually strengthening correlation between AMC and PMC might also be explained by the changes in the used sources of information to judge AMC across childhood and adolescence. It is assumed that children in early childhood mostly rely on feedback from significant others such as parents, teachers, and coaches (Horn & Hasbrook, 1986; Horn & Weiss, 1991; McKiddie & Maynard, 1997). In middle and late childhood, children often rely on peer comparison as their primary source of information to make estimations of their competence, which has been linked to more accurate estimations (Horn & Hasbrook, 1986).

Person-Centered Approach

It may be that the general low correlations between AMC and PMC in our sample, as reported earlier in this study by means of the variable-centered approach, do indicate the presence of two delimited groups of children: one group showing (very) strong positive correlations between AMC and PMC and another group revealing (very) strong negative correlations. To provide a more refined understanding of this relationship, a person-centered approach by means of cluster analyses was used. This approach identified two profiles of children with corresponding levels of AMC and PMC (i.e., relatively low-low and relatively high-high) and two profiles with divergent levels of AMC and PMC (i.e., relatively low-high and relatively high-low). These findings are in agreement with earlier studies in Belgian children (Bardid et al., 2016) and adolescents (De Meester et al., 2016a) using the same methodological approach, which indicates that those profiles might be prevalent in children and adolescents of different ages. In addition, our results also revealed that the number of children with divergent levels of AMC and PMC is higher in both age groups (i.e., 6–9 years: 54.9% and 9–12 years: 56%) than those with convergent profiles. An explanation might be that the used PMC questionnaire was not aligned with the AMC assessment (i.e., the items in the PMC questionnaire did not directly correspond to the AMC assessment), making it harder for children to provide additional relevant information about their self-perceived level of skill (True et al., 2017). However, the meta-analysis revealed that alignment between measurement instruments was not a moderator in the relationship between AMC and PMC (De Meester et al., 2020).

Regarding gender, more girls than boys have a profile characterized by relatively high AMC levels and low PMC levels in our study. One potential explanation for this finding is that girls might have lower PMC levels than their male peers with similar AMC levels. This is in agreement with the study of Cairney et al. (2012) where girls showed lower PMC than boys, which was also associated with low enjoyment of PE. Furthermore, a study of Vandendriessche et al. (2012) revealed that boys in this age group are reaching higher scores in physical performance (including AMC) when compared with girls of the same age. Since boys and girls practice together during PE classes, girls may use both male and female peers' AMC as a frame of reference to make an estimation of their own AMC, potentially resulting in lower PMC levels. In addition, it seems that boys and girls use different sources of information for PMC (Horn, Glenn, & Wentzell, 1993; McKiddie & Maynard, 1997), implying that differences in the association between AMC and PMC might exist (LeGear et al., 2012).

When it comes to age, the results of the present study show that, in the younger age group (6- to 9-year-olds), more boys than girls perceived themselves high on motor competence while in fact having a relatively low level of AMC. In the older age group (9- to 12-year-olds), more boys than girls perceived and scored themselves high on motor competence. One explanation might be that the AMC–PMC association, which is also more affected by peer comparison as children age, is additionally influenced by gender-related differences in skill performance (De Meester et al., 2020). In addition, boys attain higher AMC scores when compared with girls of the same age (Vandendriessche et al., 2012). These differences in AMC level might also affect the perceptions of skill level in both boys and girls and, thus, also affect the relation between AMC and PMC. These age- and gender-related differences were not found in the review of De Meester et al. (2020). However, to the best of our knowledge, the present study comprised a larger sample than any other study exploring the AMC–PMC relationship before and, as such, adds to the existing literature.

Since both AMC and PMC are considered to be consistent predictors of physical activity levels (Babic et al., 2014; Robinson et al., 2015), it is recommended to not only foster the development of AMC, but also to pay sufficient attention to PMC.

Strengths and Limitations

The strength of the present study is the large sample size and the inclusion of different age groups compared with other studies (Barnett et al., 2015; Khodaverdi et al., 2016; Raudsepp & Liblik, 2002; Vedul-Kjelsås et al., 2012). The sample size allowed further unraveling of the relationship between AMC and PMC across different age groups with different statistical approaches. However, there are some limitations that need to be addressed. First, the cross-sectional design of the study makes it impossible to track the strength of the relationship between AMC and PMC within subjects over time or to examine how children's AMC–PMC profile may vary over time. To gain more insight in the role of clusters and to better understand how associations between AMC and PMC may change over time, longitudinal cohort studies should be conducted. A second limitation is the lack of alignment between the AMC and PMC measurement tools in the present study. Estevan and Barnett (2018) suggested to use aligned assessment tools to measure AMC and PMC. Further research about the alignment between measurement instruments and its potential impact on the strength of the relationship between AMC and PMC is warranted.

Conclusion and Practical Implications

In this study, the variable-centered approach shows that older children display a stronger correlation (albeit it still low) between AMC and PMC than younger children, with the exception of children in the oldest age group (i.e., 11–12 years). However, the person-centered approach shows that rather than most children having PMC levels that moderately correlate with their AMC, there might in fact be two distinct profiles of children: one profile with convergent levels of AMC and PMC and one profile with divergent levels of AMC and PMC. Furthermore, the results show gender-related differences in the AMC–PMC association as well. As such, it is recommended that PE teachers and sports coaches pay sufficient attention to developing PMC in relation to AMC, especially among children with low levels of both AMC and PMC as this combination is found to be disadvantageous in terms of physical activity engagement (Robinson et al., 2015; De Meester et al., 2016). Therefore, developing all children's actual and perceived motor skills is an intervention priority. With this knowledge, it is possible to develop different approaches or interventions in a PE or sport setting, taking into account the differences that might occur in AMC and PMC between boys and girls and younger versus older children. PE teachers should approach all children in a positive manner, but next to the positive approach, it seems advisable to approach children with a low AMC–high PMC profile differently than children with a high AMC–low PMC profile. For children with low AMC and high PMC levels, the main focus should be on improving their AMC, for example, by increasing the amount of corrective feedback. For children with high AMC and low PMC levels, the main focus should be on improving their PMC, for example, by consistently applying "the sandwich principle" when providing feedback (Dohrenwend, 2002). A key factor for the development of PMC is providing structure, by means of six cornerstones: creating clarity, showing confidence and providing challenge, consistent monitoring, providing appropriate assistance, giving motivating feedback, and encouraging self-reflection. PE teachers and sports coaches can achieve these goals by using autonomy and competence supportive teaching practices and applying differentiated instruction (Vansteenkiste & Soenens, 2015).

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