British Journal of Developmental Psychology (2016), 34, 427–446

The British Psychological Society

www.wileyonlinelibrary.com

The change in perceived motor competence and motor task values during elementary school: A longitudinal cohort study

Johannes J. Noordstar[1,2]*, Janjaap van der Net[2], Suzanne Jak[3], Paul J. M. Helders[2] and Marian J. Jongmans[4,5]

[1]Bachelor Program Cesar Kinetics Therapy, University of Applied Sciences, Utrecht, The Netherlands

[2]Child Development and Exercise Center, University Medical Center Utrecht, The Netherlands

[3]Department of Methods and Statistics, Faculty of Social Sciences, Utrecht University, The Netherlands

[4]Department of Child, Family, & Education Studies, Utrecht University, The Netherlands

[5]Department of Neonatology, University Medical Center Utrecht, The Netherlands

Participation in motor activities is essential for social interaction and life satisfaction in children. Self-perceptions and task values have a central position in why children do or do not participate in (motor) activities. Investigating developmental changes in motor self-perceptions and motor task values in elementary school children would provide vital information about their participation in motor activities. We therefore examined the change in, and associations between, self-perceptions and task values of fine motor competence, ball competence, and athletic competence in 292 children from kindergarten to grade 4. We also investigated differences between boys and girls, and between children with motor problems and typically developing children. Results indicated that self-perceptions and task values are domain specific and differ between boys and girls, but not between children with motor problems and typically developing children. Self-perceptions were not associated with task values. Educators should address specific self-perceptions to enhance participation into the corresponding motor activities in children between kindergarten and grade 4, and differences in self-perceptions and task values between boys and girls should be taken into account.

Self-perceptions and task values are important determinants for children's motivation for achievement behaviour (Eccles *et al.*, 1983). Various studies have used the expectancy–value model (Eccles *et al.*, 1983) as a framework to investigate the motivation for maths, reading, and sports during childhood (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002). The model states that achievement behaviour is directly influenced by *expectations for success* and *subjective task values*. Expectations for success are, in turn, influenced by a person's ability beliefs and efficacy expectations. Ability beliefs are perceptions of

*Correspondence should be addressed to Johannes J. Noordstar, Lundlaan 6, Room KB.02.055.0, 3584 EA Utrecht, The Netherlands (email: J.Noordstar@umcutrecht.nl).

DOI:10.1111/bjdp.12142

how individuals perceive their current competence for a specific activity, while efficacy expectations are how individuals perceive their ability to do well on upcoming tasks.

Turning to the subjective task values in the expectancy–value model, Eccles *et al.* (1983) distinguished four motivational components of subjective task values: (1) attainment value, (2) intrinsic value, (3) utility value, and (4) costs. More specifically, attainment value refers to the personal importance a task has for a person. Intrinsic value refers to the enjoyment, or interest, a person has in performing the task. Utility value refers to how the task fits into a person's current or future plans, and costs refer to what a person has to give up to perform the task.

During elementary school, children develop and consolidate a variety of motor activities that will help them fully participate in society. However, little is known about how elementary school children's self-perceptions and task values about these motor activities change as they develop. Investigating developmental changes in motor self-perceptions and motor task values in elementary school children would provide insight in important determinants for children's motivation for participation in motor activities. This study focused therefore on the change in, and associations between, *ability beliefs* about motor activities (i.e., perceived motor competence) and the personal importance of being good at motor activities (i.e., motor task values) in children from kindergarten to grade 4.

Developmental changes in perceived motor competence

Studies investigating the change in perceived motor competence have focused specifically on perceived athletic competence. While, without exception, longitudinal studies have noted a decline in perceived athletic competence during childhood, the pathway and the speed of this decline differ between studies. This decline is best described by a negative linear trend during elementary school (Wigfield *et al.*, 1997) that accelerates during middle school (Fredricks & Eccles, 2002; Jacobs *et al.*, 2002). However, Cole *et al.* (2001) found that perceived athletic competence increased significantly during elementary school and only dropped noticeably during the transition from elementary school to middle school.

All studies found a decline in perceived athletic competence, though, when that decline starts differs among studies. Notably, all children have an overly optimistic perceived competence at the beginning of elementary school. As children grow older, their perceived athletic competence declines, resulting in a more realistic self-perception. Marsh and Craven (1997) argued that the reason for this decline in perceived competence comes from an increase in the performance-based feedback children receive from their teachers and parents. In addition, as children's cognitive abilities develop, they become more capable of comparing their performance with their peers instead of with their own previous performance (Harter, 2006).

Developmental changes in perceived motor competence: gender differences

Boys have a higher perceived athletic competence than girls in every grade of elementary and middle school (Cole *et al.*, 2001; Jacobs *et al.*, 2002). As the decline in perceived athletic competence is nearly identical for boys and girls, this gender difference is stable over time (Cole *et al.*, 2001; Jacobs *et al.*, 2002). Harter (2006) speculated that, historically, sports have been largely a male domain, and male sport figures would

represent more powerful role models than female sport figures, causing gender differences in favour of boys.

However, children need more than just a positive evaluation of their own (general) athletic competence to be motivated to participate in activities in daily life. For example, activities such as writing or crafts require fine motor competence, while activities such as basketball and soccer require ball competence as well as athletic competence. To our knowledge, no study has investigated these more specific perceptions of fine motor competence and ball competence longitudinally. Distinguishing between the change in perceived fine motor competence, perceived ball competence, and perceived athletic competence could give us more specific insight into the composite perceptions of leisure activities.

Based on the above findings, we hypothesized a linear decline in perceived fine motor competence, perceived ball competence, and perceived athletic competence in boys and girls. We expected boys to perceive themselves as consistently higher for athletic competence than girls. Because many ball activities (e.g., football, basketball) are part of athletic activities, we predicted perceived ball competence to be higher in boys than girls as well. However, as *actual* fine motor competence is higher in girls than boys (Junaid & Fellowes, 2006), we expected girls to *perceive* themselves as consistently higher in perceived fine motor competence than boys.

Motor task values

Few studies have investigated the change in motor task values and those that have focused solely on athletic task values (e.g., the personal importance of being good at athletic activities). In boys, athletic task values change little during elementary school, whereas in girls, they decline rapidly (Fredricks & Eccles, 2002; Jacobs *et al.*, 2002). Jacobs *et al.* (2002) found strong positive associations between the change in perceptions of athletic ability and task values in boys, but not in girls, during elementary school. For boys, both perceived athletic competence and athletic task values remain relatively high in the first years of elementary school and decline at the same rate in later years. In contrast, for girls, the athletic task values decline rapidly in the first years of elementary school before levelling off, while perceived athletic competence declines more slowly (Jacobs *et al.*, 2002).

Apart from the studies described above, few others have investigated how perceived athletic competence is related to athletic task values. Moreover, to our knowledge, no study has investigated the change in fine motor task values and ball task values or how this change is associated with the change in perceived fine motor competence and perceived ball competence. Investigating the change in motor task values and its association with perceived motor competence would provide insight into important determinants of physical and leisure participation.

We hypothesized that task values are still the same in boys and girls in kindergarten. Ball task values and athletic task values are thought to remain relatively stable in boys between kindergarten and grade 4, but decline in girls. We expected fine motor task values to stay relatively stable in girls between kindergarten and grade 4, but decline in boys. Subsequently, we expected the change in self-perceptions and task values of athletic competence and ball competence to be significantly associated in boys, but not in girls. We expected the change in perceived fine motor competence and fine motor task values to be significantly associated in girls, but not in boys.

Motor performance

School-aged children may experience difficulties in learning and performing motor skills. Various studies have found that children with motor problems are less physically active than their typically developing peers (Baerg *et al.*, 2011). Cairney *et al.* (2005) suggest that perceived athletic competence could explain why children with motor problems are less likely to participate in physical activity. Perceived athletic competence is still the same in younger children with motor problems and typically developing children (Pless, Carlsson, Sundelin, & Persson, 2001), but differences start to appear from the age of 7 years (Poulsen, Ziviani, & Cuskelly, 2006, 2008) and become more pronounced when children grow older (Piek, Baynam, & Barrett, 2006).

Children with motor problems differ in the type and severity of problems they have with activities in daily life: some are related to fine motor difficulties, while others are related to athletic difficulties. It stands to reason that perceived competence is linked to the problematic activities. Hence, gross motor difficulties are associated with perceived athletic competence in children with motor problems, while fine motor difficulties are not associated with perceived athletic competence (Piek *et al.*, 2006). Distinguishing between the types of motor problems would give us vital information for future intervention programs for children with motor problems.

We therefore investigated the differences in the change in perceived motor competence and motor task values between children with motor problems and typically developing children. Based on the above-described literature, we hypothesized that perceived motor competence is still the same in kindergarten, but we expected a steeper decline in perceived motor competence in children with motor problems than in typically developing children. To our knowledge, no study investigated the change in motor task values, or the associations between perceived motor competence and motor task values, in children with motor problems. We have therefore no clear hypothesis about differences in the change in motor task values between children with motor problems and typically developing children. We furthermore expected the change in perceived motor competence and motor task values to be significantly associated in typically developing children from kindergarten to grade 4, but are again unable to make a clear hypothesis about this association in children with motor problems.

To summarize, this study investigates the change in, and associations between, self-perceptions and task values of fine motor competence, ball competence, and athletic competence from kindergarten to grade 4. We also investigated the differences between boys and girls, and between children with motor problems and typically developing children.

Methods

The current study is part of the larger 'Move Along' [Beweeg Je Mee] longitudinal study (Noordstar, van der Net, Jak, Helders, & Jongmans, 2016). The Medical Research Ethics Committee of the University Medical Centre Utrecht approved this study.

Participants

After receiving approval from the principals of thirteen primary schools, the parents of all children in kindergarten and grade 2 received an information letter and informed consent forms (n = 1,145). A total of 307 parents gave their informed consent. Ten children dropped out during the course of the study. As we used latent growth curve modelling for

our statistical analyses, equal numbers of responses from each participant were not required. Children with missing data were, therefore, not excluded from the analysis but contributed less to the result. Some children (n = 13) had to repeat a grade or were referred to a school for special education (n = 2) during the course of the study. Because we used grade as the time interval to investigate the change in perceived motor competence and motor task values, we decided to exclude these children. Therefore, a total of 292 children divided over two cohorts were included in this study. The first assessment took place between January and June 2011 (Time 1). The following assessments took place as close as possible to the same date, 12 (Time 2) and 24 (Time 3) months later. Cohort I consisted of children in kindergarten (n = 146; 80 boys), while cohort II consisted of children in grade 2 (n = 146; 68 boys). Children in cohort I were 5.36 (0.52) years and children in cohort II were 7.38 (0.52) years at first assessment.

We used the movement assessment battery for children – second edition (MABC-2) to investigate the motor performance to identify children with motor problems (Henderson, Sugden, & Barnett, 2007). This test is divided into three different age bands (3–6, 7–10, and 11–16 years) each consists of eight items to measure children's motor performance. The eight items are divided into three subsets: manual dexterity (three items), aiming and catching (two items), and balance (three items). Raw scores are converted into standard scores (1–19) and percentile scores (0–100), so results can be compared with peers. Scores above the 16th percentile are regarded as normal motor performance. Scores between the 6th and 16th percentile are considered 'at risk' for motor difficulties and scores below the 6th percentile indicate significant motor difficulties. The MABC-2 has reasonable to good clinical utility in identifying children with motor performance differences (Brown & Lalor, 2009).

The MABC-2 was carried out on Time 1, Time 2, and Time 3. Children were categorized as having motor problems for a specific subset if they scored below the 16th percentile on at least two measurement occasions to ensure motor problems were persistent over time, resulting in 31 children (25 boys) with motor problems in their fine motor competence, 8 children (3 boys) with motor problems in their ball competence, and 2 children (1 boy) with motor problems in their balance (Table 1).

Measures

How Am I Doing questionnaire

Perceived motor competence and motor task values were assessed by asking children to complete the How Am I Doing questionnaire (Calame *et al.*, 2009). This questionnaire consists of 13 items that can be divided into three subsets: fine motor activities (five items), ball activities (three items), and athletic activities (five items). Every activity is scored on a 4-point scale (maximum score 52) with higher scores indicating a more positive perception of motor competence or motor task values. The questionnaire was developed for children aged 6–12 years. Firstly, children were presented a photo of a specific motor activity (e.g., throwing, climbing, and handwriting) and were asked how they perceived themselves in performing the specific motor activity, for example, 'how good do you perceive yourself at climbing' (perceived motor competence). Secondly, for every item, children were asked how important it was for them to be good at performing this specific motor activity, for example, 'how important is it for you to be good at climbing' (motor task value).

Previously reported internal consistency (Cronbach's alpha) was acceptable for perceived fine motor competence (α = .60), perceived ball competence (α = .64), and perceived athletic competence (α = .63). Internal consistency was only reported for the

Table 1. Characteristics of the children

	Cohort I (n = 146)	Cohort II (n = 146)
Gender (boys/girls)	80/66	68/78
Ethnicity (Caucasian/Ethnic minorities)	121/25	119/27
Motor performance (TD/MP)		
Fine motor competence	126/16	128/15
Ball competence	140/2	137/6
Balance	140/2	143/0
Mean age (*SD*)		
Time 1	5.36 (0.52)	7.38 (0.52)
Time 2	6.34 (0.52)	8.38 (0.52)
Time 3	7.34 (0.52)	9.37 (0.51)

Note. TD, typically developing children; MP, children with motor problems.

Table 2. Mean scores perceived motor competence and motor task values per cohort

	Perceived motor competence, Mean (*SD*)			Motor task values, Mean (*SD*)		
	Fine motor competence	Ball competence	Athletic competence	Fine motor task values	Ball task values	Athletic task values
Cohort I						
KG (n = 146)	15.23 (2.39)	9.19 (1.65)	18.20 (1.77)	15.97 (3.08)	8.46 (2.34)	16.20 (2.87)
Grade 1 (n = 142)	15.17 (2.15)	9.16 (1.59)	18.13 (1.57)	15.32 (2.54)	8.44 (2.13)	15.36 (2.47)
Grade 2 (n = 140)	15.15 (2.34)	9.10 (1.56)	18.16 (1.51)	15.24 (2.72)	8.31 (2.00)	15.17 (2.15)
Cohort II						
Grade 2 (n = 146)	15.38 (2.39)	8.74 (1.75)	18.01 (1.62)	16.05 (2.31)	8.16 (1.81)	15.32 (2.01)
Grade 3 (n = 143)	15.50 (2.33)	9.01 (1.49)	17.80 (1.72)	15.89 (2.14)	8.42 (1.81)	15.69 (2.13)
Grade 4 (n = 142)	15.38 (2.28)	8.78 (1.38)	17.30 (1.62)	15.63 (2.58)	8.37 (1.67)	15.27 (2.11)

Note. KG, Kindergarten; *SD*, standard deviation.

total score of motor task values, but found acceptable (α = .66; Volman, 2009). In our sample, Cronbach's alpha differed per subscale and, overall, increased as children became older (i.e., perceived fine motor competence (α = .15–.52), perceived ball competence (α = .24–.59), perceived athletic competence (α = .32–.52), fine motor task values (α = .48–.72), ball task values (α = .24–.59), and athletic task values (α = .45–.64; see Supporting information for Cronbach's alpha's per grade). Scores on the How Am I Doing questionnaire are reported in Tables 2–4.

Procedure

Children were individually assessed in a quiet room at their school. Because the children in this study were younger than children in previous studies using this questionnaire, great care was taken to ensure that the children understood the questions being asked. All questions were read out loud to all the children.

Analysis

We used a cohort-sequential design to investigate the change in perceived motor competence and motor task values. This cohort-sequential design provides a way to link

Table 3. Mean scores perceived motor competence and motor task values for boys and girls

	Perceived motor competence, Mean (*SD*)			Motor task values, Mean (*SD*)		
	Fine motor competence	Ball competence	Athletic competence	Fine motor task values	Ball task values	Athletic task values
Boys						
KG (n = 80)	14.79 (2.34)	9.58 (1.65)	18.13 (1.88)	15.60 (3.24)	9.11 (2.22)	16.35 (3.07)
Grade 1 (n = 79)	14.76 (2.15)	9.81 (1.42)	18.34 (1.53)	15.10 (2.76)	8.92 (2.10)	15.30 (2.71)
Grade 2 (n = 146)	14.27 (2.22)	9.40 (1.52)	18.05 (1.56)	15.40 (2.77)	8.61 (1.96)	15.29 (2.12)
Grade 3 (n = 66)	14.41 (2.30)	9.44 (1.43)	17.48 (1.77)	15.76 (2.29)	8.83 (1.93)	15.68 (2.38)
Grade 4 (n = 66)	14.59 (2.33)	9.24 (1.14)	17.20 (1.60)	15.47 (2.79)	8.65 (1.80)	15.24 (2.36)
Girls						
KG (n = 66)	15.77 (2.35)	8.73 (1.55)	18.29 (1.64)	16.42 (2.83)	7.67 (2.26)	16.02 (2.62)
Grade 1 (n = 63)	15.68 (2.05)	8.35 (1.43)	17.86 (1.60)	15.59 (2.21)	7.84 (2.02)	15.43 (2.15)
Grade 2 (n = 140)	16.31 (2.03)	8.41 (1.67)	18.12 (1.57)	15.93 (2.27)	7.84 (1.77)	15.20 (2.04)
Grade 3 (n = 77)	16.43 (1.92)	8.65 (1.45)	18.08 (1.64)	16.00 (2.01)	8.06 (1.63)	15.70 (1.91)
Grade 4 (n = 76)	16.07 (2.02)	8.38 (1.45)	17.38 (1.64)	15.78 (2.39)	8.13 (1.52)	15.30 (1.88)

Note. KG, Kindergarten.

cohorts to determine whether there is a common developmental growth curve (Duncan, Duncan, Strycker, & Chaumeton, 2007; Schaie, 1965). In this way, it is possible to connect several short-term longitudinal studies of different age cohorts to investigate the change in perceived motor competence and motor task values over a longer period of time. The growth curve of perceived motor competence and motor task values was fitted on latent variables, implying that measurements errors are taken into account. We constrained intercepts and factor loadings to be equal across years, which is an important prerequisite for comparing common factors across time (McArdle, 2009; Oort, 2001; see Supporting information for constrained factor loadings).

Firstly, we performed several preliminary analyses to make sure latent growth curves analyses could be investigated accordingly. Preliminary analysis consisted of the following: (1) testing for measurement invariance in perceived motor competence and motor task values for gender and age and (2) testing for dependence due to the nested structure in the data because children were clustered within school.

Secondly, we conducted a linear growth model (McArdle, 1988; Meredith & Tisak, 1990) on common factors for perceived motor competence and motor task values that assumed that the change in perceived motor competence and motor task values can be modelled with a latent intercept (initial status) and slope (linear change), which can vary across children (the intercept and slope may have variance).

Thirdly, if significant variance on intercept or slope between children was found we added gender and motor performance as a covariate to investigate whether gender and motor performance could explain part of the variance in intercept and slope in perceived motor competence and motor task values. Explained variance (R^2) of the intercept and slope is reported in Tables 5 and 6.

Finally, we investigated the associations between the change in perceived motor competence and motor task values. Using multigroup models, we tested whether these associations differed across gender and motor performance.

Statistical analyses were performed in M*plus* 7.0, using Bayesian estimation with the default settings in the program. M*plus* provides 95% confidence intervals for parameter

Table 4. Mean scores perceived motor competence and motor task values per grade

	Perceived motor competence, Mean (*SD*)			Motor task values, Mean (*SD*)		
	Fine motor competence	Ball competence	Athletic competence	Fine motor task values	Ball task values	Athletic task values
MP children						
KG (*n*)	14.38 (2.80) (*16*)	7.50 (0.71) (*2*)	18.00 (2.83) (*2*)	16.25 (2.79) (*16*)	8.50 (0.71) (*2*)	17.00 (4.24) (*2*)
Grade 1 (*n*)	15.13 (2.42) (*16*)	9.00 (2.83) (*2*)	17.50 (0.71) (*2*)	15.38 (3.26) (*16*)	11.00 (1.41) (*2*)	17.50 (2.12) (*2*)
Grade 2 (*n*)	13.81 (2.21) (*31*)	7.50 (0.76) (*8*)	16.50 (0.71) (*2*)	15.19 (2.75) (*31*)	7.88 (1.25) (*8*)	15.00 (1.41) (*2*)
Grade 3 (*n*)	13.80 (2.37) (*15*)	7.83 (1.17) (*6*)	– (–) (*0*)	15.27 (2.55) (*15*)	9.33 (2.16) (*6*)	– (–) (*0*)
Grade 4 (*n*)	13.13 (2.33) (*15*)	7.50 (1.38) (*6*)	– (–) (*0*)	14.47 (3.16) (*15*)	8.67 (1.75) (*6*)	– (–) (*0*)
TD children						
KG (*n*)	15.44 (2.21) (*126*)	9.26 (1.63) (*140*)	18.24 (1.75) (*140*)	15.90 (3.10) (*126*)	8.44 (2.36) (*140*)	16.12 (2.87) (*140*)
Grade 1 (*n*)	15.17 (2.12) (*126*)	9.16 (1.59) (*140*)	18.14 (1.58) (*140*)	15.31 (2.44) (*126*)	8.41 (2.12) (*140*)	15.33 (2.47) (*140*)
Grade 2 (*n*)	15.44 (2.32) (*252*)	8.95 (1.67) (*275*)	18.12 (1.55) (*281*)	15.71 (2.53) (*252*)	8.25 (1.93) (*275*)	15.26 (2.09) (*281*)
Grade 3 (*n*)	15.70 (2.25) (*128*)	9.07 (1.48) (*137*)	17.80 (1.72) (*143*)	15.96 (2.09) (*128*)	8.38 (1.79) (*137*)	15.69 (2.13) (*143*)
Grade 4 (*n*)	15.65 (2.14) (*127*)	8.84 (1.36) (*137*)	17.30 (1.62) (*142*)	15.77 (2.48) (*127*)	8.36 (1.67) (*137*)	15.27 (2.11) (*142*)

Note. KG, Kindergarten; *SD*, standard deviation; TD children, typically developing children; MP children, children with motor performance.

Table 5. Perceived motor competence unstandardized results

	Fine motor competence		Ball competence		Athletic competence	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Intercept (mean)	0.00	–	0.00	–	0.00	–
Slope (mean)	−0.12*	−0.16, −0.07	−0.02	−0.05, 0.01	−0.07*	−0.11, −0.05
Intercept on gender (*b*)	0.27*	0.09, 0.45	−0.29*	−0.42, −0.18	−0.02	−0.16, 0.14
Slope on gender (*b*)	0.07	−0.01, 0.15	0.02	−0.03, 0.06	0.02	−0.04, 0.08
R^2 intercept by gender	0.21	0.02, 0.68	0.40	0.16, 0.73	0.01	0.00, 0.15
R^2 slope by gender	0.07	0.00, 0.42	0.05	0.00, 0.56	0.03	0.00, 0.44
Intercept on motor performance (*b*)	0.22	−0.06, 0.49	0.36	−0.10, 0.88	−0.07	−0.07, 0.64
Slope on motor performance (*b*)	0.09	−0.03, 0.22	0.01	−0.15, 0.16	0.28	−0.15, 0.75
R^2 intercept by motor performance	0.08	0.00, 0.49	0.05	0.00, 0.26	0.01	0.00, 0.09
R^2 slope by motor performance	0.07	0.00, 0.43	0.03	0.00, 0.54	0.09	0.00, 0.68

Note. CI, confidence interval.
*$p < .05$.

Table 6. Motor task values

	Fine motor competence		Ball competence		Athletic competence	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Intercept (mean)	0.00	–	0.00	–	0.00	–
Slope (mean)	−0.02	−0.06, 0.02	0.00	−0.03, 0.04	−0.02	−0.05, 0.01
Intercept on gender (*b*)	0.17	−0.01, 0.38	−0.39*	−0.58, −0.22	−0.05	−0.20, 0.11
Slope on gender (*b*)	−0.03	−0.11, 0.05	0.06	0.00, 0.13	0.00	−0.06, 0.06
R^2 intercept by gender	0.05	0.00, 0.23	0.25	0.08, 0.53	0.02	0.00, 0.17
R^2 slope by gender	0.01	0.00, 0.18	0.08	0.00, 0.47	0.02	0.00, 0.40
Intercept on motor performance (*b*)	−0.08	−0.37, 0.20	0.09	−0.52, 0.76	−0.74	−1.64, 0.04
Slope on motor performance (*b*)	0.09	−0.02, 0.21	−0.08	−0.30, 0.13	0.39	−0.08, 0.91
R^2 intercept by motor performance	0.01	0.00, 0.10	0.01	0.00, 0.11	0.05	0.01, 0.27
R^2 slope by motor performance	0.04	0.00, 0.33	0.02	0.00, 0.29	0.19	0.01, 0.81

Note. CI, confidence interval.
*$p < .05$.

estimates, which gives the 95% probability that the population parameter will lie between the lower and upper value of the interval. (For more information about Bayesian methods in general, see Lynch [2007], for the specific implementation in M*plus*, see Muthen [2010].) M*plus* also provides *p* values for parameter estimates,

which are related to the confidence intervals. They were evaluated against a significance level of .05.

Results

Preliminary analyses

All tables with the results of the preliminary analyses are reported in Supporting information. We found small violations of measurement invariance across boys and girls on specific items. These violations were not consistent across time points and are not expected to affect the results. With regard to age, we tested invariance in perceived motor competence and motor task values between children in kindergarten and grade 4 as possible age differences were expected to be largest between youngest and oldest children. We found some differences on intercept or factor loading of specific items, mostly in favour of children in kindergarten at the start of the study. However, we did not expect that these small differences will affect the results substantially. Because the children were clustered within schools, it would be desirable to correct for the nested structure in the analysis. However, the option to correct for the multilevel structure is not available with Bayesian estimation in *Mplus*. Ignoring nestedness may lead to inflated type I errors (Snijders & Bosker, 1999). Effect on parameter estimates in a factor model are found to be ignorable when the intraclass correlations (ICC) < .15, and the influence on standard errors is very small when ICC < .25 and ignorable when ICC < .05 (Pornprasertmanit, Lee, & Preacher, 2014). The item's ICC s for schools ranged between .00 and .19 and are therefore not expected to influence the results.

The change in perceived motor competence

Perceived fine motor competence and perceived athletic competence declined from kindergarten to grade 4, while perceived ball competence stayed the same. Variance between children was significant for intercept and slope for all domains.

Girls perceived themselves as higher in fine motor competence than boys in kindergarten, while boys perceived themselves as higher in ball competence in kindergarten than girls. Perceived athletic competence was the same in boys and girls in kindergarten. The change in perceived fine motor competence, perceived ball competence, and perceived athletic competence was the same in boys and girls, indicating that gender differences in perceived fine motor competence and perceived ball competence stay relatively the same over time.

Perceived fine motor competence, perceived ball competence, and perceived athletic competence was the same in children with motor problems in the corresponding domain and typically developing children in kindergarten. The change in perceived fine motor competence, perceived ball competence, and perceived athletic competence was also the same in children with motor problems in the corresponding domain and typically developing children (Table 5).

The change in motor task values

Fine motor task values, ball task values, and athletic task values stayed the same from kindergarten to grade 4. Variance between children was significant for intercept and slope in all domains.

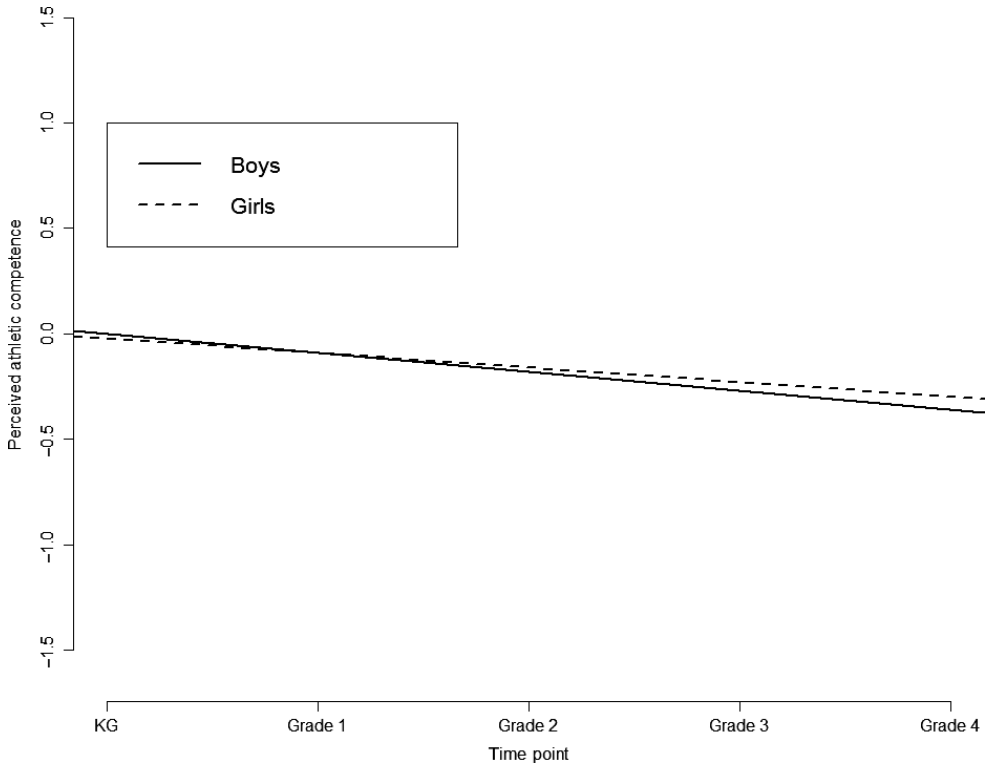

Figure 1. Perceived athletic competence: Average growth curve for boys and girls.

Boys valued their ball competence as higher than girls in kindergarten, but valued their fine motor competence and athletic competence the same as girls in kindergarten. The change in fine motor task values, ball task values, and athletic task values was the same in boys and girls.

Fine motor task values, ball task values, and athletic task values were the same in children with motor problems in the corresponding domain and typically developing children in kindergarten. The change in fine motor task values, ball task values, and athletic task values was also the same in children with motor problems in the corresponding domain and typically developing children (Table 6; Figures 1–6).

Associations between perceived motor competence and motor task values

Overall, there were no significant associations between the change in perceptions and task values for fine motor competence[1], ball competence, or athletic competence. Also, associations were not significantly different between boys and girls for fine motor competence, ball competence, and athletic competence, nor significantly different between children with motor problems in the corresponding domain and typically

[1] *Associations between perceived fine motor competence and fine motor task values could only be investigated without residual variance covariance between questions.*

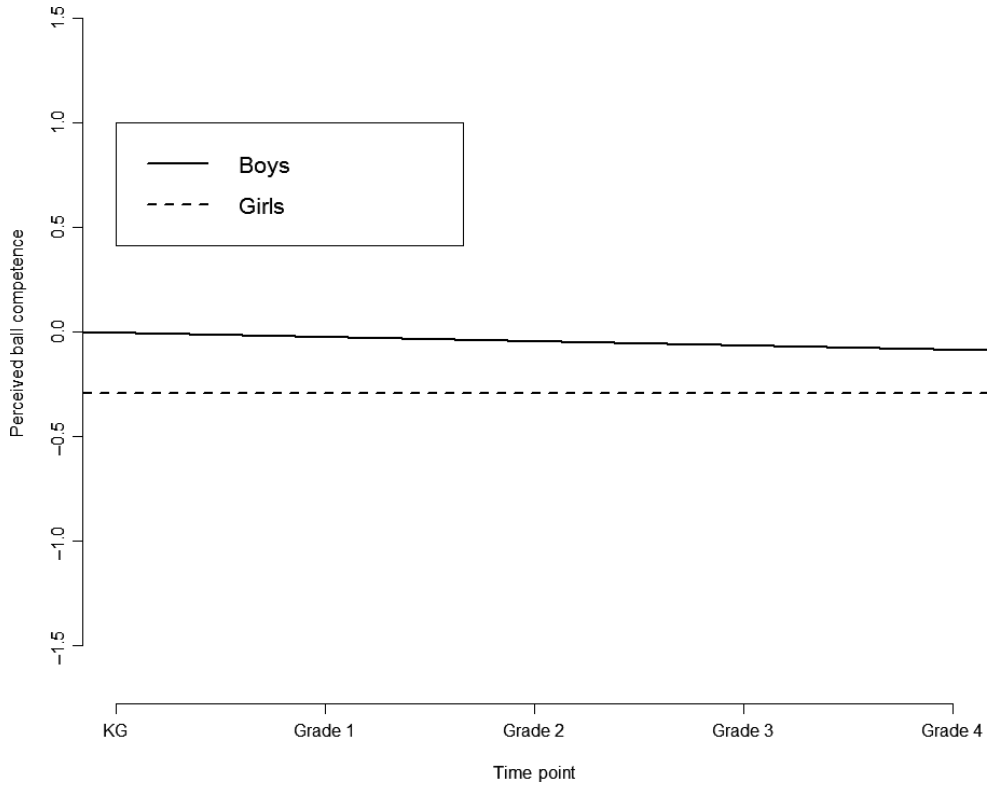

Figure 2. Perceived ball competence: Average growth curve for boys and girls.

developing children for fine motor competence, ball competence, and athletic competence (Table 7).

Discussion

The change in perceived motor competence

As hypothesized, perceived athletic competence and perceived fine motor competence declined over time. However, perceived ball competence remained the same. We speculated that this unexpected result is due to the activities the children were asked to evaluate themselves on regarding perceived ball competence (i.e., aiming, catching, and throwing). The result of the performance itself is possibly more obvious in ball activities for the child than in fine motor activities and athletic activities. Children are therefore better able to monitor their own progress and, subsequently, more inclined to compare their current performance to their previous performance instead of comparing their performance to their peers. Because actual motor competence improves as children grow older, their aiming, catching, and throwing will improve. So, on the one hand, perceptions increase because children are actually getting better in performing the ball activities they are asked to evaluate, while, on the other hand, perceptions decline over time because of cognitive development. These two counteracting factors might have resulted in a stable perceived ball competence. Future studies should investigate the longitudinal associations between perceived ball competence and *actual* ball competence to better

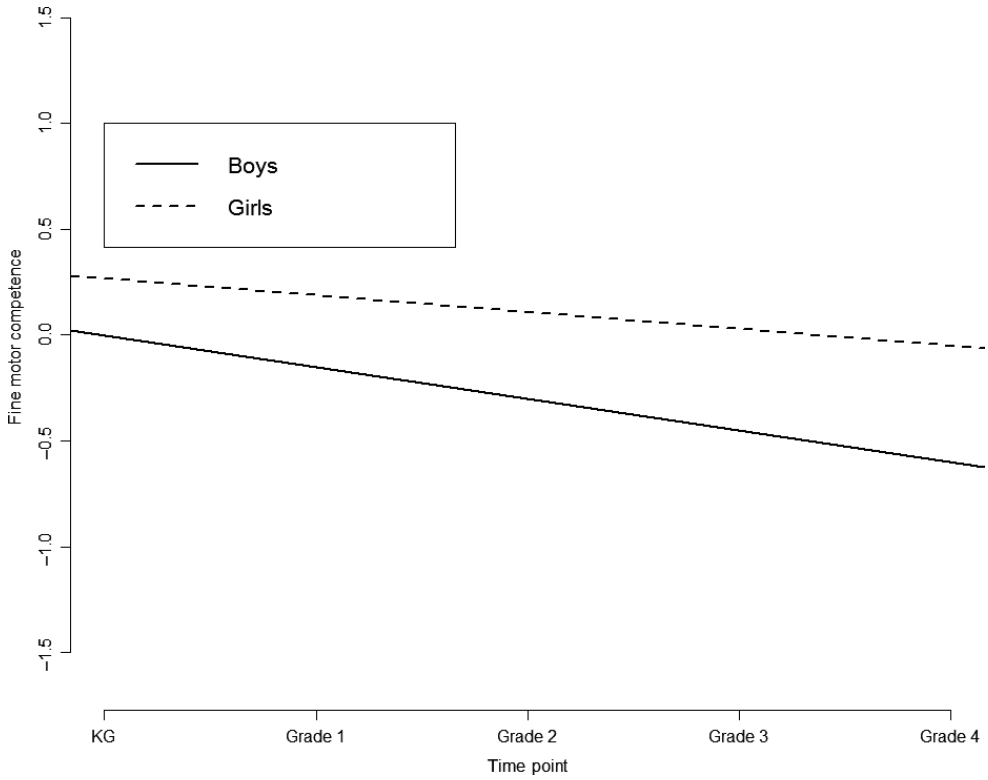

Figure 3. Fine motor competence: Average growth curve for boys and girls.

understand the developmental changes in perceived ball competence in children, which has also been suggested by others (Barnett, Ridgers, & Salmon, 2015).

As hypothesized, girls perceived their fine motor competence as higher from kindergarten to grade 4 than boys, while boys perceived their ball competence as higher from kindergarten to grade 4 than girls. We found no differences in perceived athletic competence, unlike in other studies where boys perceived their athletic competence as higher than girls in elementary school (Jacobs *et al.*, 2002; Muldoon, 2000). This unexpected result possibly stem from the difference in questionnaires used to investigate the perceived athletic competence between studies. The items that we used to investigate the perceived athletic competence are less 'gender specific' than the items used in other studies (Jacobs *et al.*, 2002). For example, we investigated the perceptions of hopping, bicycling, swimming, climbing, and running, while other studies investigated a more global construct of athletic abilities (e.g., how do you perceive yourself in sports).

We found no differences in self-perceptions between children with motor problems and typically developing children. We argued that this unexpected result is due to the small number of children with motor problems in this study. Because the stability of motor performance in children is low (Roze *et al.*, 2010), we decided to categorize children as having motor problems only if they scored below the 16th percentile on at least two (of the three) measurement occasions to make sure motor problems were persistent over time. This resulted in a small number of children who experienced motor problems in their manual dexterity ($n = 31$), ball skills ($n = 8$), and balance ($n = 2$). If we categorized

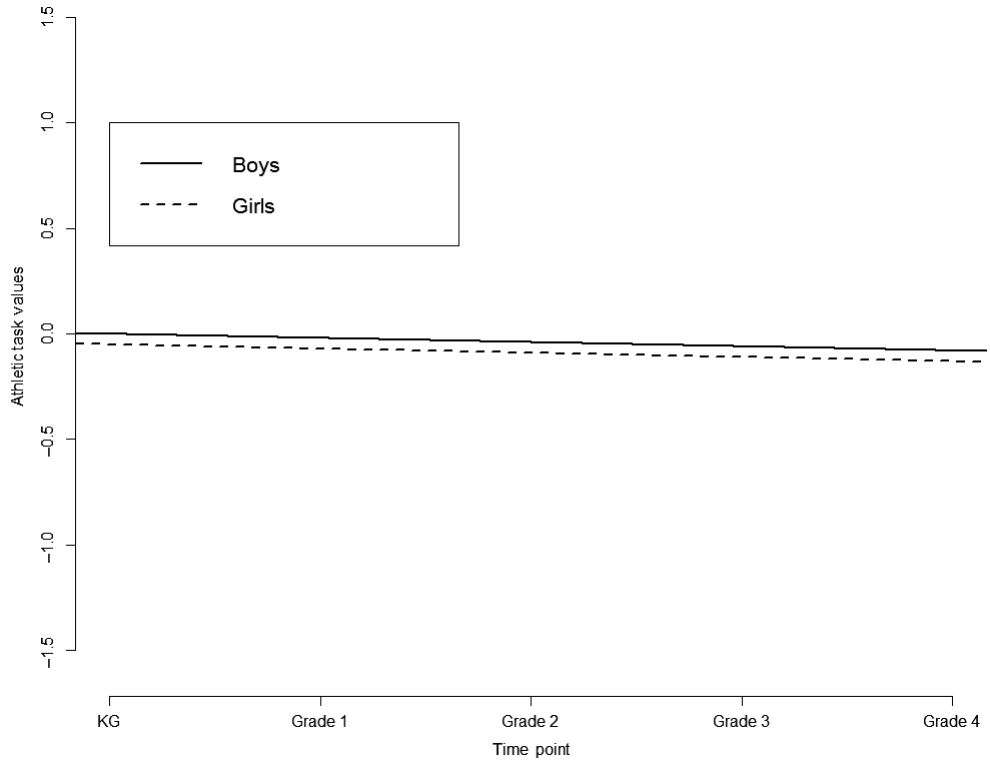

Figure 4. Athletic task values: Average growth curve for boys and girls.

children as having motor problems when they scored below the 16th percentile only on one occasion, 82 children experienced motor problems in their manual dexterity, 42 children experienced motor problems in their ball skills, and 13 children experienced motor problems in their balance. However, the outcome of identical statistical analyses as reported here still showed no differences between children with motor problems and typically developing children, with the exception of perceived fine motor competence whereby children with motor problems scored lower than typically developing children in kindergarten. This difference remained the same over time. We expected that children receive, as early as kindergarten, more feedback from parents and teachers about their fine motor competence (e.g., crafts, handwriting) than about their ball competence and athletic competence. Also, fine motor competence lends itself well for comparison between (younger) children. We therefore argued that children who experience problems in their fine motor competence also perceive their fine motor competence as lower than typically developing children from kindergarten to grade 4.

The change in motor task values

Task values stayed the same over time. Boys valued their ball competence as higher than girls from kindergarten to grade 4, while task values of fine motor competence and athletic competence were the same in boys and girls over time. These results are not in agreement with Jacobs *et al.* (2002), who found large differences in the change in athletic task values between boys and girls during elementary school. We argued that the questions asked to

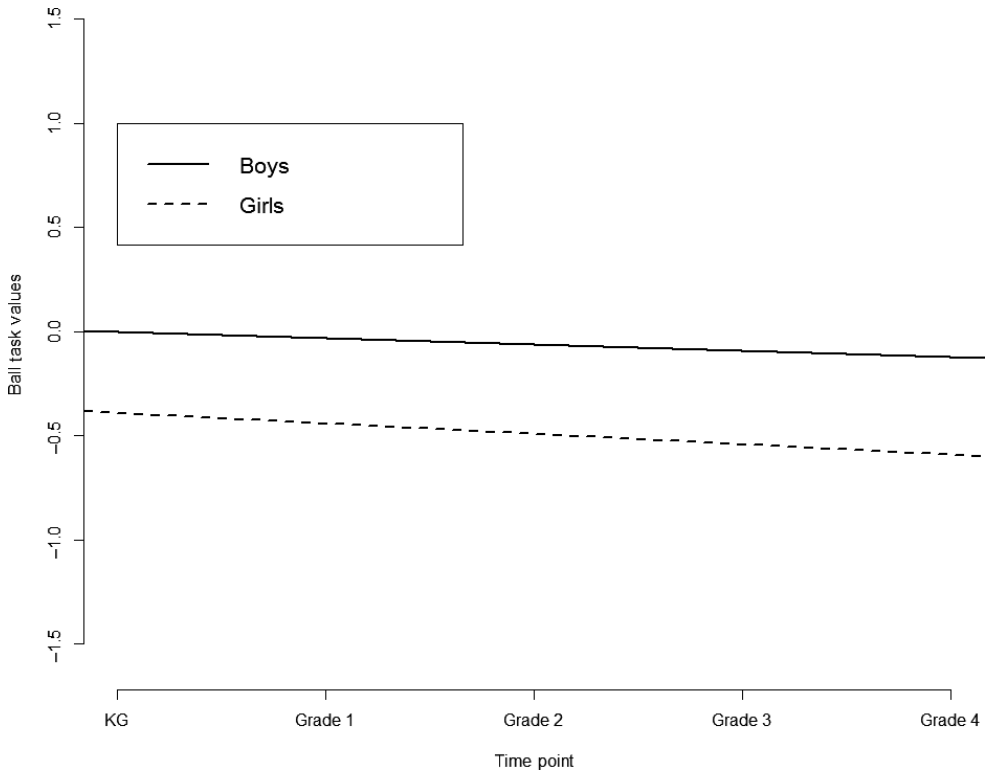

Figure 5. Ball task values: Average growth curve for boys and girls.

investigate the fine motor task values and athletic task values consist of activities that are essential for daily life (e.g., swimming, handwriting, tying shoelaces). Although we found a decline in self-perceptions of fine motor competence and athletic competence, children are aware that these activities are important in daily life, equally so for boys and girls. Interestingly, we found the same gender differences and developmental changes in perceived ball competence and ball task values. Barnett *et al.* (2015) also found that girls aged 4–8 had a lower perceived ball competence than boys. We extended their findings by investigating these gender differences longitudinally and in ball task values.

As hypothesized, we found no differences in task values between children with motor problems and typically developing children. However, this result should be interpreted with caution because of the small number of children with motor problems.

Associations between the change in perceived motor competence and motor task values

We found, unexpectedly, no associations between self-perceptions and task values. However, we argued, as mentioned before, that children are aware that the activities asked to investigate the perceived motor competence and motor task values are important for daily life, equally so for boys and girls. Self-perceptions of fine motor competence and athletic competence declined at the same rate in boys and girls, while task values remained stable in boys in girls. From a statistical perspective, this results in a non-significant difference in associations between boys and girls.

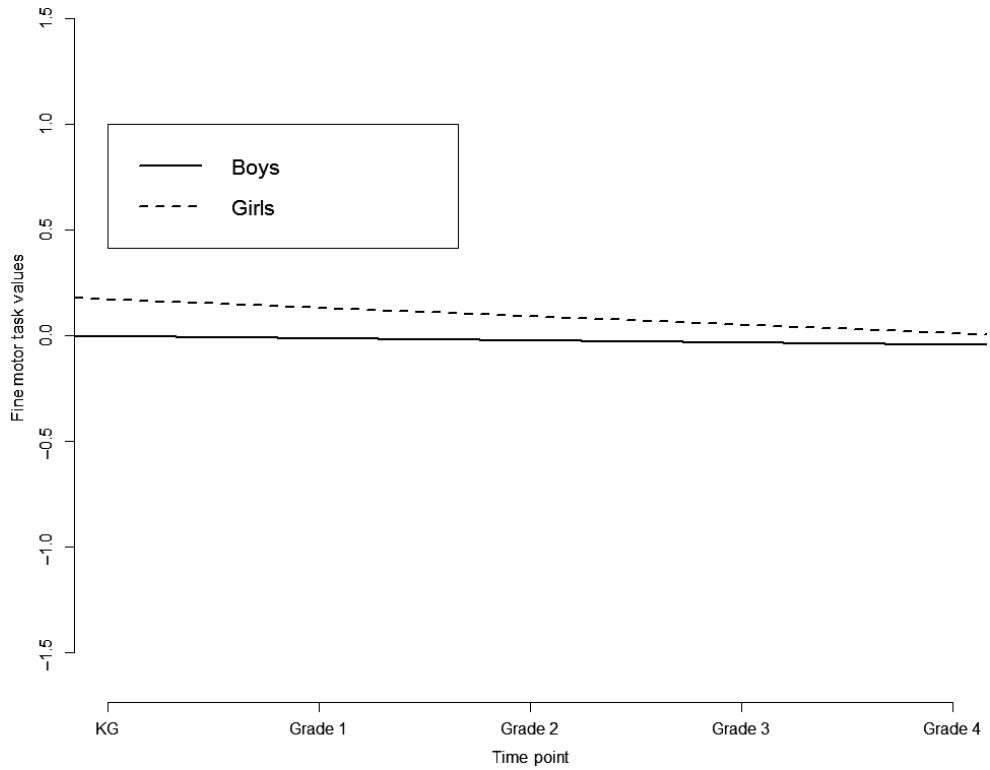

Figure 6. Fine motor task values: Average growth curve for boys and girls.

Table 7. Associations between perceived motor competence and motor task values

	Fine motor competence		Ball competence		Athletic competence	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Association	−0.01	−0.01, 0.02	0.01	0.00, 0.01	0.00	0.00, 0.01
Boys	0.02	−0.01, 0.04	0.03	0.00, 0.05	0.12*	0.00, 0.18
Girls	−0.01	−0.04, 0.01	0.01	−0.01, 0.02	0.03	−0.01, 0.04
$cov_{boys} - cov_{girls}$	−0.03	−0.06, 0.00	−0.02	−0.05, 0.01	−0.09	−0.14, 0.00
$r_{boys} - r_{girls}$	−0.70	−1.37, 0.09	−0.15	−1.03, 0.79	0.04	−1.16, 0.41
Children with MP	0.00	−0.10, 0.09	−0.61	−7.78, 1.91	7.90	−11.80, 23.85
Typ. children	0.00	−0.01, 0.01	0.00	0.00, 0.01	0.04*	0.01, 0.25
$cov_{mp} - cov_{typ}$	0.00	−0.09, 0.10	0.61	−1.90, 7.78	−7.83	−23.79, 11.82
$r_{mp} - r_{typ}$	0.05	−1.01, 1.11	0.52	−0.39, 1.48	0.47	−0.25, 1.41

Notes. CI, confidence interval; cov, covariance; *r*, correlation; MP, motor problems; Typ. children, typically developing children.
*$p < .05$.

As mentioned before, the small number of children with motor problems is most likely the primary reason for not finding differences in perceived motor competence and motor task values between children with motor problems and typically developing children.

This also results in a non-significant difference in associations between children with motor problems and typically developing children.

Weaknesses and strengths

Several limitations have to be recognized. First, we have limited psychometric knowledge about the How Am I Doing questionnaire. To evaluate this limitation, we investigated the factor loadings of the items on the corresponding latent variable. Factor loadings of perceived fine motor competence and perceived athletic competence were generally low, but statistically significant, indicating that the validity and reliability of the observed scores were questionable. Factor loadings of perceived ball competence and task values were not high, but substantial, and statistically significant. Although the reliability of the used measures was not satisfactory according to Cronbach's alpha, we noted that the growth models were fitted on the common factors, and not on the observed scores. The common factor represents the true score part of the observed variables. Therefore, although the measurement error in the observed indicators was large, the measurement errors are accounted for by the latent variable model (Bollen, 1989). The low reliability of the measurements indicated that the observed scores of this questionnaire should not be used to make predictions or decisions at the individual level. SEM analysis, however, can still provide unbiased estimates of population parameters (DeShon, 1998). Moreover, the measurement invariance analysis showed that measurement parameters were generally equal across age and gender, so that the change in the latent variables can be evaluated without age or gender bias (Widaman, Ferrer, & Conger, 2010). Secondly, only a small number of children were categorized as having motor problems on the subsets ball skills and balance of the MABC-2. Future research should also include children with motor problems who are clinically referred (e.g., developmental coordination disorder) to increase the number of children with motor problems to obtain a better understanding about the influence of motor problems on self-perceptions and task values. Thirdly, we did not specifically test children for any neurodevelopmental disorders (e.g., developmental coordination disorder [DCD], cerebral palsy [CP]) that might have been associated with motor difficulties, and so this may have affected the results. Finally, the order in which children performed the MABC-2 and the How Am I Doing Questionnaire was at random. Children were assessed on two separate occasions (mostly on the same day or within 1 or 2 days) because we argued that the length of the total assessment would have a negative influence on the child's concentration and, therefore, performance. In doing so, children might be aware about their motor performance if the MABC-2 was administered first, having a possible influence on their perceived motor competence. However, we argued that this impact is negligible because self-perceptions about specific activities are asked in the How Am I Doing questionnaire, which are not assessed with the MABC-2.

In terms of strengths, our longitudinal design allowed us to investigate the developmental changes in, and associations between, self-perceptions and task values. We investigated the changes in self-perceptions and task values on a latent level. By fitting the growth model on factors instead of scale scores, measurement error at the item level is taken into account by the measurement model (Preacher, Wichman, MacCallum, & Briggs, 2008). Also, this is the first study that distinguished between self-perceptions and task values of fine motor competence, ball competence, and athletic competence in elementary school children. In doing so, more specific insight is provided about the change in, and associations between, self-perceptions and task values.

To conclude, our study expands the knowledge on self-perceptions and task values in fine motor competence, ball competence, and athletic competence in elementary school children. We found that the change in self-perceptions and task values, and differences between boys and girls, was domain specific. This information can be used to help educators understand why, and why not, children participate in daily activities that require motor competence. Educators should address specific self-perceptions to enhance participation into the corresponding motor activities in children between kindergarten and grade 4, and differences in self-perceptions and task values between boys and girls should be taken into account. Future research should, as suggested by the expectancy–value model, investigate how self-perceptions and task values influence daily activities in the corresponding domain, taking developmental and gender differences into account.

Acknowledgements

We thank the teachers, parents, and students who made this research possible. Also, we are grateful to Prof. Dr. H. J. A. Hoijtink for his contribution to the statistical analyses and Taylor Krohn for her work in editing this manuscript.

References

Baerg, S., Cairney, J., Hay, J., Rempel, L., Mahlberg, N., & Faught, B. E. (2011). Evaluating physical activity using accelerometry in children at risk of developmental coordination disorder in the presence of attention deficit hyperactivity disorder. *Research in Developmental Disabilities*, *32*, 1343–1350.

Barnett, L. M., Ridgers, N. D., & Salmon, J. (2015). Associations between young children's perceived and actual ball skill competence and physical activity. *Journal of Science and Medicine in Sport*, *18*, 167–171. doi:10.1016/j.jsams.2014.03.001

Bollen, K. A. (1989). *Structural equations with latent variables*. New York, NY: Wiley.

Brown, T., & Lalor, A. (2009). The movement assessment battery for children – Second edition (MABC-2): A review and critique. *Physical & Occupational Therapy in Pediatrics*, *29*, 86–103. doi:10.1080/01942630802574908

Cairney, J., Hay, J. A., Faught, B. E., Wade, T. J., Corna, L., & Flouris, A. (2005). Developmental coordination disorder, generalized self-efficacy toward physical activity, and participation in organized and free play activities. *The Journal of Pediatrics*, *147*, 515–520. doi:10.1016/j.jpeds.2005.05.013

Calame, E., Reinders, H., Smits, B. C. M., Schoemaker, M. M., Volman, M. J. M., & de Kloet, A. (2009). *Hoe ik vind dat ik het doe vragenlijst: Vragenlijst motorische competentiebeleving [How Am I Doing questionnaire: A questionnaire to investigate perceived motor competence]*. Unpublished manuscript.

Cole, D. A., Maxwell, S. E., Martin, J. M., Peeke, L. G., Seroczynski, A. D., Tram, J. M., . . . Maschman, T. (2001). The development of multiple domains of child and adolescent self-concept: A cohort sequential longitudinal design. *Child Development*, *72*, 1723–1746. doi:10.1111/1467-8624.00375

DeShon, R. P. (1998). A cautionary note on measurement error corrections in structural equation models. *Psychological Methods*, *3*, 412–423. doi:10.1037/1082-989X.3.4.412

Duncan, S. C., Duncan, T. E., Strycker, L. A., & Chaumeton, N. R. (2007). A cohort-sequential latent growth model of physical activity from ages 12 to 17 years. *Annals of Behavioral Medicine*, *33*, 80–89. doi:10.1207/s15324796abm3301_9

Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 77–146). San Francisco, CA: W.H. Freeman.

Fredricks, J. A., & Eccles, J. S. (2002). Children's competence and value beliefs from childhood through adolescence: Growth trajectories in two male-sex-typed domains. *Developmental Psychology*, *38*, 519–533. doi:10.1037/0012-1649.38.4.519

Harter, S. (2006). The self. In N. Eisenberg, W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology, 6th edition, Volume 3: Social, emotional, and personality development* (pp. 505–570). Hoboken, NJ: John Wiley.

Henderson, S. E., Sugden, D. A., & Barnett, A. (2007). *Movement assessment battery for children – Second edition [Movement ABC-2]*. London, UK: The Psychological Corporation.

Jacobs, J. E., Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development*, *73*, 509–527. doi:10.1111/1467-8624.00421

Junaid, K. A., & Fellowes, S. (2006). Gender differences in the attainment of motor skills on the movement assessment battery for children. *Physical & Occupational Therapy in Pediatrics*, *26*, 5–12. doi:10.1300/j006v26n01_02

Lynch, S. (2007). *Introduction to applied Bayesian statistics and estimation for social scientists*. New York, NY: Springer.

Marsh, H. W., & Craven, R. G. (1997). Academic self-concept: Beyond the dustbowl. In G. Phye (Ed.), *Handbook of classroom assessment: Learning, achievement and adjustment*. San Diego, CA: Academic Press.

McArdle, J. J. (1988). Dynamic but structural equation modeling of repeated measures data. In J. R. Nesselroade & R. B. Cattell (Eds.), *Handbook of multivariate experimental psychology: Perspectives on individual differences* (pp. 561–614). New York, NY: Plenum Press.

McArdle, J. J. (2009). Latent variable modeling of differences and changes with longitudinal data. *Annual Review of Psychology*, *60*, 577–605. doi:10.1146/annurev.psych.60.110707.163612

Meredith, W., & Tisak, J. (1990). Latent curve analysis. *Psychometrika*, *55*, 107–122. doi:10.1007/bf02294746

Muldoon, O. T. (2000). Social group membership and self-perceptions in Northern Irish children: A longitudinal study. *British Journal of Developmental Psychology*, *18*, 65–80. doi:10.1348/026151000165571

Muthen, B. (2010). *Bayesian analysis in Mplus: A brief introduction.* Unpublished manuscript. Retrieved from http://www.statmodel.com

Noordstar, J. J., van der Net, J., Jak, S., Helders, P. J. M., & Jongmans, M. J. (2016). Global self-esteem, perceived athletic competence, and physical activity in children: A longitudinal cohort study. *Psychology of Sport and Exercise*, *22*, 83–90. doi:10.1016/j.psychsport.2015.06.009

Oort, F. J. (2001). Three-mode models for multivariate longitudinal data. *The British Journal of Mathematical and Statistical Psychology*, *54*, 49–78. doi:10.1348/000711001159429

Piek, J. P., Baynam, G. B., & Barrett, N. C. (2006). The relationship between fine and gross motor ability, self-perceptions and self-worth in children and adolescents. *Human Movement Science*, *25*, 65–75. doi:10.1016/j.humov.2005.10.011

Pless, M., Carlsson, M., Sundelin, C., & Persson, K. (2001). Pre-school children with developmental co-ordination disorder: Self-perceived competence and group motor skill intervention. *Acta Paediatrica*, *90*, 532–538. doi:10.1080/080352501750197674

Pornprasertmanit, S., Lee, J., & Preacher, K. J. (2014). Ignoring clustering in confirmatory factor analysis: Some consequences for model fit and standardized parameter estimates. *Multivariate Behavioral Research*, *49*, 518–543. doi:10.1080/00273171.2014.933762

Poulsen, A. A., Ziviani, J. M., & Cuskelly, M. (2006). General self-concept and life satisfaction for boys with differing levels of physical coordination: The role of goal orientations and leisure participation. *Human Movement Science*, *25*, 839–860. doi:10.1016/j.humov.2006.05.003

Poulsen, A. A., Ziviani, J. M., & Cuskelly, M. (2008). Leisure time physical activity energy expenditure in boys with developmental coordination disorder: The role of peer relations self-concept perceptions. *OTJR: Occupation, Participation and Health*, *28*, 30–39. doi:10.3928/15394492-20080101-05

Preacher, K. J., Wichman, A. L., MacCallum, R. C., & Briggs, N. E. (2008). *Latent growth curve modeling*. Thousand Oaks, CA: Sage.

Roze, E., Meijer, L., Van Braeckel, K. N., Ruiter, S. A., Bruggink, J. L., & Bos, A. F. (2010). Developmental trajectories from birth to school age in healthy term-born children. *Pediatrics*, *126*, e1134–e1142. doi:10.1542/peds.2010-0698

Schaie, K. W. (1965). A general model for the study of developmental problems. *Psychological Bulletin*, *64*, 92–107. doi:10.1037/h0022371

Snijders, T. A. B., & Bosker, R. J. (1999). *Multilevel analysis: An introduction to basic and advanced multilevel modeling*. Thousand Oaks, CA: Sage.

Volman, M. J. M. (2009, June). *'How Am I Doing', A new pictorial scale for perceived athletic competence for children aged 6 to 12 years*. Poster session presented at the VIII International Conference on DCD, Baltimore, MD.

Widaman, K. F., Ferrer, E., & Conger, R. D. (2010). Factorial invariance within longitudinal structural equation models: Measuring the same construct across time. *Child Development Perspectives*, *4*, 10–18. doi:10.1111/j.1750-8606.2009.00110.x

Wigfield, A., Harold, R. D., Freedman-Doan, C., Eccles, J. S., Yoon, K. S., Arbreton, A. J., & Blumfield, P. C. (1997). Change in children's competence beliefs and subjective task values across the primary school years: A 3-year study. *Journal of Educational Psychology*, *89*, 451–469. doi:10.1037/0022-0663.89.3.451

Received 3 March 2015; revised version received 11 December 2015

Supporting Information

The following supporting information may be found in the online edition of the article:

Table S1. Cronbach alpha per subscale per grade.

Table S2. Factor loadings for perceived athletic competence and athletic task values per grade (n = 292).

Table S3. Factor loadings for perceived ball competence and ball task values per grade (n = 292).

Table S4. Factor loadings for perceived fine motor competence and fine motor task values per grade (n = 292).

Table S5. Degrees of freedom, χ^2, lower and upper bound of the RMSEA and conclusion about bias for model with strong factorial invariance across gender in each grade.

Table S6. Degrees of freedom, χ^2, lower and upper bound of the 90% confidence interval around the RMSEA and conclusion about bias for model with strong factorial invariance across children in kindergarten vs children in Grade 4.

Table S7. Intraclass correlations for schools.