Assessment of movement skill performance in preschool children: Convergent validity between MOT 4-6 and M-ABC

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Abstract
The purpose was to determine the level of agreement between the Motoriktest für Vier- bis Sechsjährige Kinder [MOT 4-6] and the Movement Assessment Battery for Children [M-ABC]. 48 preschool children participated in the study (Mean age = 5 years, 6 months, SD = 3 months). There was high classification agreement (90%) between both tests. A Kappa correlation coefficient (0.67) provided moderately strong support for convergent validity. Less agreement was shown in identification of motor difficulties (58%). This was reflected by lower correlation coefficients on the fine movement cluster and test item level. The MOT 4-6 showed values within the range of similar movement skill performance assessment protocols. Because of its specific focus it may be of meaningful value to assess movement skill competence in typically developing preschool children (ages 4 to 6).

Key words: Early childhood, psychomotor performance, task performance and analysis, sports, fundamental movement skill, exercise.

Introduction

Fundamental movement skills [FMS] form the basis for daily living as well as for participation in physical activities. Young children already benefit from good coordination and control of movement when engaged in physical activity, play, sports and social interactions (Larkin and Summers, 2004). Although motor development is a process continuing throughout life, early childhood is the optimal phase to learn and develop FMS (Gallahue and Ozmun, 2006). This development is established through an interactive process of aspects related to the individual, the task and the environment (Newell, 1985). These aspects include biological and other personal variables (physical growth, maturation, gender, motivation), environmental variables (neighborhood surroundings, socioeconomic status [SES], socializing agents), variables of practice (experience, exercise) and task variables (Barreiros, 2008).

During the past decades, motor development research has primarily focused on motor impairment among children (Yoon et al., 2006), for which various assessment tools have been developed. These tools usually assess quantitative aspects of movement skill tasks and focus on the children's skill performance which reflects the 'product' of the movement on the performed task. Mostly these tools specifically focus on early detection and charting of deficits in the development of the perceptual-motor system (Bruininks and Bruininks, 2005; Henderson et al., 2007; Smits-Engelsman et al., 1998; Zimmer and Volkamer, 1987). Other tests assess the qualitative aspects of the movement skill tasks and focus on the movements of the children's body parts during task performance which emphasizes on the 'process' of the movement task (Burton and Miller, 1998). These tools help to identify difficulties in the children's movement behavior itself. In the school context, a third kind of assessment tool has been developed: pupil monitoring instruments (SIG, 2005; van Gelder and Stroes, 2002). These tools are used to control to what extent individual preschool children meet the curricular developmental goals. A number of these tools are currently used by Flemish preschool teachers to follow up children's individual progress in movement skills. The advantage of these instruments is that they show individual task shortcomings. The disadvantage is that they do not provide a general estimate of the child's developmental movement skill status. The opportunity to centralize these data to obtain an overall view of movement skill development among preschool children has remained largely unexplored.

As stated before, structured child assessment would be valuable because movement skill performance assessment in preschool children contributes to an early and broad insight to children's movement skill development. Movement skill assessment tools might provide additional information on children's movement skill difficulties and effectiveness.

To monitor and assess movement skill development and performance in individual children as well as in larger samples of the population, reliable and valid instruments are required. Van Waelvelde et al. (2007) indicate that movement skill assessment of preschool children is a topic of research that can benefit from additional independent validity and reliability studies of currently used assessment protocols for various populations. This study therefore compares (a) the MOT 4-6 and (b) the M-ABC assessment protocol's results. Both assessment protocols are included in the non-limitative list of motor assessment protocols of the Belgian social security service (RIZIV, 2002). Their characteristics will be briefly discussed.

The MOT 4-6 (Zimmer and Volkamer, 1987) has promising assets to be used in fieldwork. The assessment protocol is accessible, easy to use and specifically designed for preschool children. The tool has a high assessment protocol efficiency which becomes evident by its

favorable assessment protocol item/time proportion. The substantial number and broad spectrum of assessment protocol items included in the MOT 4-6 meets one of the assessment tool criteria as outlined by Netelenbos (2001). Another advantage of the protocol is that gross as well as fine movement skill assessment items have been included, which completes the physical activity (PA) related skill practice. However, subscales for fine and gross movement skill performance are not included in the MOT 4-6 protocol. The assessment protocol's specific preschool child orientation is reflected by the attractive character of assessment protocol items and the variation in the order in which different tasks follow one another during the assessment. The absence of an English translated version creates a language barrier that may have led to limited assessment protocol use. Following this limitation, very few additional studies have been performed on the psychometric qualities of the assessment protocol including validity and reliability studies. Except for the data provided in the MOT 4-6 assessment protocol manual, further psychometric data is scarce (Cools et al., 2009a).

M-ABC assessment protocol (Henderson and Sugden, 1992), on the contrary, is widely used in movement skill assessment among young children. For this tool, more extensive research on psychometric qualities is available (Barnett and Henderson, 1998). One of the main reasons for this availability of research is the M-ABC's international character. We decided to compare the MOT 4-6 protocol with the M-ABC protocol because the latter is widely used.

The aim of this study was to examine the screening agreement between the MOT 4-6 (Zimmer and Volkamer, 1987) and the M-ABC assessment protocol (Smits-Engelsman, 1998). This study investigated convergent validity between the fine, gross and total movement skill scores. Agreement on identification of children with motor difficulties was investigated and individual assessment protocol item correlations were used to clarify possible assessment protocol differences. Additionally, discriminant validity between gross and fine motor constructs and the total scores within each assessment protocol were studied. Research on usability of psychomotor assessment protocols in Flemish preschool children is scarce and limited (Vanvuchelen, 2005). Therefore, this study also aimed to fill up this gap.

Methods

Participants
In this study, 48 preschool children (23 girls, 25 boys) between 5 and 6 years of age agreed to participate (Mean age = 5 years 6 months, SD = 3 months) (The data was collected in March 2006).

A cluster sample of children from two Flemish preschools was invited for participation. They were individually assessed with both assessment protocols at a one week interval. A criterion for inclusion was that children had to be free from any apparent developmental disability. Well informed teachers confirmed that all participants met this criterion. Since none of the instruments provided separate normative data for males and females, boys as well as girls were invited to participate. Prior to the assessment, parent's informed consent and children's assent was obtained. Only a few parents did not give consent for the assessment of their child. These children did not perform the assessment protocol but there was no reason to believe this biased the sample. The study design (assessment of children with a one week interval) did not allow re-invitation of preschool children absent on the day of assessment. The study was approved by the university's medical ethical committee.

Instruments
The MOT 4-6 as well as the M-ABC are branches of the Oseretsky assessment family tree (Simons, 2004). The two assessment tools include both fine and gross movement skill assessment protocol items and refer to a norm. The composite or total scores are summed assessment protocol item scores and represent an estimation of the children's movement skill performance (Burton and Miller, 1998). For both instruments the standardized manuals include exact descriptions of each item: task description, required material, assessment protocol instructions, specific simple instructions for the child and specific rating scales. Brief descriptions of the MOT 4-6's and M-ABC's assessment protocol items are shown in Table 1.

Motoriktest für Vier- bis Sechsjährige Kinder [MOT 4-6] (Zimmer and Volkamer, 1987). The MOT 4-6 includes 18 items that are divided into four major performance areas: (a) stability, (b) locomotion, (c) object control and (d) fine movement skills. The assessment protocol primarlily identifies a child's developmental movement skill status at an early age (Bös, 2001). Additionally, the assessment protocol creates an opportunity for early detection of motor difficulties (Zimmer and Volkamer, 1987). The authors argued that preschool children need a specific pedagogical approach differing from primary school children and therefore limited the age range of the assessment protocol to children between 4 and 6 years of age. As described in the assessment

Table 1. Test item description of the MOT 4-6 and the M-ABC (age band one: 4 to 6 y)

MOT 4-6		M-ABC (age band one)
1. Forward jump in a hoop /	10. Collecting matches *	1. Posting coins in a bank box*
2. Forward balance #	11. Passing through a hoop #	2. Threading beads*
3. Placing dots on a sheet*	12. Jumping in a hoop on 1 foot, standing on 1 leg #	3. Drawing a line into a trail*
4. Grasping a tissue with toes*	13. Catching a tennis ring #	4. Catching a bean bag #
5. Sideward jump #	14. Jumping Jacks #	5. Rolling a ball into a goal #
6. Catching a stick #	15. Jumping over a cord #	6. Standing on one leg #
7. Carrying balls from box to box #	16. Rolling around the length axe of the body #	7. Jumping over a cord #
8. Reverse balance #	17. Standing up holding a ball on the head #	8. Walking heels raised on a line #
9. Throwing at a target disk #	18. Jump and turn in a hoop #	

= Gross Motor skill test item, * = Fine Motor skill test item, / = Test item not rated because it was used to accustom the child to the test situation.

protocol manual, presentation of subsequent items of the different movement skill performance areas are alternated in order to guarantee maximum appeal. Zimmer and Volkamer (1987) reported high test and retest reliability (r = 0.85), high split-half reliability (α = 0.80), as well as high internal consistency (α = 0.81). High concurrent validity with Kiphard and Shilling 's Körper Koordinationtest [KTK] (1974) was also reported (r = 0.78).

Movement Assessment Battery for Children [M-ABC] (Dutch version) (Smits-Engelsman, 1998). The M-ABC includes eight individual assessment protocol items that assess children's fundamental movement skill performance over three movement skill categories: (a) balance skills, (b) ball skills and (c) manual dexterity skills. The checklists that are included in the M-ABC assessment protocol are outside the scope of this article and will not be discussed. Henderson and Sugden (1992) and Smits-Engelsman (1998) state that the assessment protocol may be used for: (a) screening or identifying children for special services, (b) clinical exploration, intervention planning and program evaluation and (c) description of the delay's magnitude. The assessment protocol has four age bands that allow assessment protocol use for children between 4 and 12 years of age. All children in this sample were assessed with the assessment protocol items from the first age band (4 to 6 years). In addition to data on reliability and validity presented in the assessment protocol manual (Smits-Engelsman, 1998), elaborate research on reliability and validity has been reported (Cools et al., 2009a). Van Waelvelde et al. (2007) showed low agreement between PDMS-2 and M-ABC on identification of motor difficulties (Cohen's kappa = 0.29) and high correlation between the assessment protocols' total scores (r_s = 0.76) for children from a clinical setting. Lower correlations were shown between both assessment protocol's fine motor subscores (r_s = 0.48) than between their respective gross motor (r_s = 0.71) subscores. Croce, Horvat and McCratty (2001) showed high concurrent validity correlation coefficients between M-ABC and Bruininks-Oseretsky assessment protocol (Pearson r = 0.77 to 0.79 for 5 to 6 year olds), as well as high test and retest intraclass correlation coefficients [ICC] across one week (.98 for 5 to 6 year-olds). Agreement on test-retest performance across one week for classification above or below the 15th percentile cut-off was 78% (Henderson and Sugden, 1992). Chow and Henderson (2003) showed high test-retest reliability ICC's (0.77 in 4- to 5-year-old preschool children). Suitability of USA norms was found not to be stable across children of all ages, e.g. adjustments are needed to assess 5 but not 4 year old typical preschool children in Flanders (Van Waelvelde et al., 2008).

Scoring details

The children's performance on each MOT 4-6 assessment protocol item is converted into scores ranging from 0 (skill not mastered) to 2 (skill mastered). The total motor score resulted from adding up all item scores and generating a score out of a possible total of 34. The higher the children scored on the MOT 4-6 assessment protocol, the higher their movement skill level. The most important conversions for the total score were: (a) percentiles and

(b) Motor Quotients (MQ).

Each M-ABC assessment protocol item was rated on a 6-point rating scale in which 5 equaled the weakest performance and 0 equaled the best performance. The Total Impairment Score (TIS) on the M-ABC assessment protocol resulted from adding up all item scores, generating a possible total score of 40 and expressed the child's skill mastery level. In contrast with the scoring on the MOT 4-6, achieving higher scores on the M-ABC indicated weaker movement skill development. Apart from the total impairment score, three profile scores of the categories: (a) balance skills, (b) ball skills and (c) manual dexterity skills provided more specific information on skill performance. Negative correlation coefficient values between the assessments with both assessment protocols were expected because of the MOT 4-6's and M-ABC's contrasting score system (high movement performance was represented by high scores on the MOT 4-6 and low scores on the M-ABC). In this study, both assessment tools were used to screen children's movement skill performance. MQ and TIS were calculated respectively for the MOT4-6 assessment protocol and the M-ABC assessment protocol.

Procedure

Each child was assessed individually in a separate room to conform to assessment protocol instructions. The assessments were administered at a one week interval, once with the MOT 4-6 assessment protocol and once with the M-ABC assessment protocol. The order of administering the two assessment protocols was counterbalanced for the children of the two schools. Both assessment tools were used in accordance with the directions specified in the manual and performed by two trained examiners. As described in the respective assessment protocol manuals, administering time for the MOT 4-6 was about 15 to 20 minutes and about 20 to 30 minutes for the M-ABC assessment protocol. For both assessment protocols high interrater reliability correlation coefficients were reported (r $_{M-ABC}$ >.85, r $_{MOT\ 4-6}$ = .93) (Smits-Engelsman, 1998; Cools et al., 2009b).

Data Analysis

Descriptive statistics were used to show children's movement skill performance. Distribution of total scores, classification of children in movement skill categories as well as variance of total scores, motor quotient [MQ] and total impairment score [TIS] were reported. Assignment of children to movement skill categories was based on normative data from the assessment protocol manuals. To estimate the level of agreement between the assessment protocols, children were divided into two groups based on each assessment protocol's cut-off scores: (a) children with scores at or below the 15th (M-ABC) and 16th (MOT 4-6) percentile, (b) children with scores above these cut-off scores. The level of agreement between the assessment protocols was examined in dichotomy using a Cohen's kappa statistic.

Intra- and inter-test score correlations were processed using correlation coefficients. For total scores, Pearson correlation coefficients were used because assumptions for normality were met. For clustered scores, Spearman rank correlation coefficients were used because

assumptions for normality of data were not met. Spearman Rank correlation coefficients were also used on assessment protocol item level following the ordinal nature of the scaled scores on assessment protocol item level. To obtain fine and gross movement cluster scores from the MOT 4-6 and M-ABC additional aggregated scores were required. Procedures were adopted from a similar study (Van Waelvelde et al., 2007) which clustered and added up scores related to gross motor main actions and item scores related to fine motor main actions. Cluster scores were aggregated based on the suggested classification of assessment protocol items shown in Table 1. The authors of the MOT 4-6 suggested a categorization of assessment protocol items based on the main action of the skill performed in each assessment protocol item (Zimmer and Volkamer, 1987). Assessment protocol item 3 (placing dots), 4 (grasping tissue with toe) and 10 (collecting matches) were indicated as fine motor skills and assessment protocol item scores were added up to a fine motor component (MOT 4-6 FM). The remaining MOT 4-6 assessment protocol items were added up to a gross motor component (MOT 4-6 GM). Van Waelvelde et al. (2007) proposed that the M-ABC assessment protocol's manual Dexterity cluster score may represented the M-ABC assessment protocol's fine motor score (M-ABC FM) and the sum of the ball skills and balance score may represent the M-ABC assessment protocol's gross motor score (M-ABC GM). Finally, the MOT 4-6's individual assessment protocol scores were compared to each M-ABC cluster score. To reduce type I errors P-value was set to p ≤ .01.

Results

Prior to the analysis of performance data, possible school effects on preschool children's performance were verified. Children's performances did not differ significantly between the two schools ($t_{MOT\ 4-6}$ = 0.59, ns; t_{M-ABC} = -1.42 , ns).

Table 2. Classification of children in different performance categories of the MOT 4-6 and the M-ABC (n = 48).

MOT 4-6 / M-ABC	MOT 4-6	M-ABC
1 Conspicuous/ Motor impaired	2 (4.2%)	2 (4.2%)
2 Under average / At risk	9 (18.8%)	6 (12.5%)
3 Average / Normal	36 (75.0%)	40 (83.3%)
4 Good / -	1 (2.1%)	
5 Very good / -	0	

Distribution of children's movement performance

The children's MOT 4-6 mean performance was 19 (SD = 4.8) with a range between 4 and 27. Children's M-ABC mean performance was 5 (SD = 4.6) with a range between 0 and 21. Children were classified using the specific cate-

gorization of each assessment protocol. These results are shown in Table 2. The M-ABC did not subdivide children scoring above the 15th percentile cut-off, thus the categories 'good' and 'very good', which occurred in MOT 4-6 classification, were marked grey for the M-ABC. Differences appeared in classification of children in the categories 1, 2 and 3 for both assessment protocols. In addition, inconsistency appeared in category 1 as each assessment protocol identified two children in the category 'conspicuous / motor impaired', but these were different children for each assessment protocol. Following the difference in classification categories, it was recommended to convert these data into more comparable categories such as using a cut-off score to identify motor difficulties (as presented in Table 3).

Table 3. Number of children meeting the MOT 4-6's and M-ABC's own pass/fail criteria.

		M-ABC		
		≤ Pc 15th	> Pc 15th	Total
MOT 4-6	≤ Pc 16th	7	4	11
	> Pc 16th	1	36	37
	Total	8	40	48

Agreement on movement skill performance classification between MOT 4-6 and M-ABC

Results of classification by each assessment protocol's individual cut-off score were shown in Table 3. A Cohen's kappa of 0.67 (95% CI between 0.41 and 0.93) provided moderate support for identification of motor difficulties between the MOT 4-6 and the M-ABC. The composite proportion of agreement between the identification of the MOT 4-6 and the M-ABC was 90% (95% CI between 77% and 96%). Agreement of each category was 88% for classifying children above and 58% for classifying children below each assessment protocol's individual cut-off score.

Values of correspondence within and between the MOT 4-6 and M-ABC scores and subscores

Correlations within and between the various scores and subscores of the MOT 4-6 and M-ABC are shown in Table 4. Respective high (for gross motor subscore) and moderate (for fine motor subscore) correlation coefficients supported construct validity of the assessment protocols. The absence of correlation between the fine and gross motor subscores of each assessment protocol supported discrimination between fine and gross constructs.

A moderate correlation coefficient between the total scores (r = - 0.68, p < 0.01) supported correspondence. Forty-six percent of the variance in children's performance on the MOT 4-6 was explained by the children's

Table 4. Values of Correlation Coefficients between clustered scores of the MOT 4-6 and the M-ABC (n = 48).

	MOT 4-6 GM	MOT 4-6 FM	M-ABC TOTAL	M-ABC GM	M-ABC FM
MOT 4-6 TOTAL	.95**	.43**	-.68**	-.50**	-.33*
MOT 4-6 GM		.18	-.64**	-.54**	-.37*
MOT 4-6 FM			-.05	-.07	-.29*
M-ABC Total				.90**	.46**
M-ABC GM					.14

** p < 0.01. * p < 0.05, MOT 4-6 GM = sum of Gross Motor item scores of the MOT 4-6 (2,5,6,7,8,9,11,12,13,14,15,16,17,18); MOT 4-6 FM = sum of Fine Motor item scores of the MOT 4-6 (3,4,10); M-ABC GM = sum of Gross Motor subscores of the M-ABC (subscore ball skills + balance); M-ABC FM = Fine Motor subscore of the M-ABC (subscore dexterity)

Table 5. Correlations between the MOT 4-6's 17 skill item scores and the M-ABC's 3 cluster scores.

	Manual dexterity	Ball Skills	Balance
Forward Balance	ns	ns	ns
Placing Dots	ns	ns	.310 **
Grasping	ns	ns	ns
Sideward Jump	ns	ns	- .431*
Catching a Stick	ns	ns	ns
Run	ns	-.319 **	ns
Reverse Balance	ns	ns	ns
Throw	ns	ns	ns
Collect Matches	- .387 *	ns	ns
Passing through a hoop	- .339 **	ns	ns
One Leg Stand	ns	ns	- .483 *
Catch	ns	- .487	ns
Jumping Jacks	ns	ns	ns
Height Jump	- .349 **	- .435 *	- .654 *
Body Roll	ns	ns	ns
Stand Up	ns	ns	- .373 *
Jump Turn	ns	ns	- .417 *

** $p \leq 0.01$, * $p < .05$, ns = non significant.

performance on the M-ABC. Moderate correlation coefficients supported correspondence between each assessment protocol's gross motor scores. Forty percent of the variance in children's performance on gross movement skill tasks of the MOT 4-6 was explained by their performance on gross movement skill tasks of the M-ABC. Correspondence between the assessment protocols' fine movement skill scores was supported by low correlation coefficients. Fifteen percent of the variance in children's performance on the fine movement skill tasks of the MOT 4-6 was explained by their performance on the fine movement skill tasks of the M-ABC.

Values of correspondence between and within item scores of the MOT 4-6 and M-ABC cluster scores
Table 5 shows correlation coefficients between individual test item scores (MOT 4-6) and cluster scores (M-ABC). No significant correlation coefficients and low correlation coefficients provided very limited support for correspondence between test items scores (MOT 4-6) and cluster scores (M-ABC). Inconsistency in the correlation between the fine movement skill test items (MOT 4-6) and the fine movement skill cluster (M-ABC) appeared. A moderate correlation coefficient supported correspondence between the 'collecting matches' item (MOT 4-6) and the manual dexterity cluster (M-ABC) but no support was found between the 'placing dots' item (MOT 4-6) and the dexterity cluster (M-ABC). Among the gross motor skill performances some inconsistencies appeared as well. Significant correlation between the 'height jump' item (MOT 4-6) and the ball skill cluster (M-ABC) provided moderate support for correspondence. Support for correspondence was found between the 'catching' skill item and the ball skill cluster score (M-ABC). This was not the case not for the 'throwing' item (MOT 4-6). Finally, conflicting results also appeared in the correlation coefficients between the balance related test items (MOT 4-6) and the balance cluster (M-ABC). The 'forward-' and

'reverse balance' test items (MOT 4-6) in particular showed no correlation with the balance skill cluster (M-ABC) and thus correspondence was not supported.

Discussion

Inter-test results showed moderately strong support for correspondence of results between the MOT 4-6's and M-ABC's total scores as well as for the gross and fine movement skill cluster scores. Low agreement and inconsistencies existed between the MOT 4-6's item scores and the M-ABC's cluster scores. Intra-test correlation coefficients showed comparable results on the MOT 4-6's and M-ABC's gross (high) and fine (moderate) movement skills. The absence of correlation between fine and gross movement skill clusters provided support for discrimination between fine and gross motor constructs. Results also showed a high proportion of agreement (90%) in classification of children. A moderately strong correlation (Kappa = 0.67) was shown for identifying children with movement skill difficulties. There was higher classification agreement above than below each test's cut-off score. In addition, this agreement was absent when children were further classified as motor impaired (category conspicuous/motor impaired).

Correlation coefficients between the MOT 4-6 and M-ABC have shown to be within the range of the M-ABC's test comparisons with other assessment tools such as the PDMS-2 (Peabody Developmental Motor Scales-2), BOT LF (Bruininks Oseretsky Test Long Form), BOT SF (Bruininks Oseretsky Short Form), VMI (Test for Visual motor integration), COMPS (Clinical Observation of Postural and Motor skills) and KTK (Körperkoordinations Test für Kinder) (range between 0.23 and 0.90) (Croce et al., 2001; Larkin and Rose, 2005; Smits-Engelsman et al., 1998; Van Waelvelde et al., 2007). Differences in explained variance and low to moderate correlations confirm earlier concern on the difficulty of the use of move-

ment skill performance tests. The human motor system includes a larger number of mutually independent skills. Therefore, assessment protocols should include a substantial number of movement skills (Netelenbos, 2003).

Results have shown moderate correlation between the MOT 4-6's and M-ABC's total scores as well as in the dichotomy in classification of children with motor difficulties. This result supports convergent validity and indicates that the tests measure similar constructs. The interpretation of this result can go in two directions. One explanation is that the correlation reflects the tests' overlap in content and supports the assumption that movement skill tasks are dependent upon more than one factor (Fleishman 1978). The alternative explanation is that the extent of common variance supports the assumption of a factor that underlies a 'general motor ability' as described by Burton and Rodgerson (2001). The correlation between the gross movement skill cluster scores (MOT 4-6 / M-ABC) provided moderate evidence for convergent validity. The fine movement skill scores were less highly correlated and provided much smaller evidence for convergent validity. The small number of fine movement skill tasks included in both tests and the variety in scope of the tasks influenced strength of correlation. For example, low inter-correlation could be attributed to the difference in the principal movement action between the 'placing dots' item (MOT 4-6) and the 'drawing a bicycle trial' (M-ABC).

In this study, results have shown that more children with difficulties were identified with the MOT 4-6 test in comparison to the M-ABC. Smits-Engelsman (1998) argued that tests based on a sample of German children (such as the KTK test) seemed to be more sensitive than the M-ABC and consequently overestimated Dutch children's movement skill competence. Contrasting to this, Van Waelvelde et al. (2008) concluded that the M-ABC overestimated 5-year-old Flemish children's performance and thus the M-ABC was shown to identify less children with motor difficulties than was expected. Forthcoming, it is not recommended to accept the premise that German normative data overestimate Flemish children's performances. The disagreement between assessment tools in detection of motor impairment might also partially be attributed to the various cut-off scores used for identification by the different motor tests (Larkin and Rose, 2005). These findings also support the concern of low agreement between assessment tools on the identification of children with motor difficulties (Maeland, 1992). We must acknowledge that these results have pointed out a difference in sensitivity between the MOT 4-6 and M-ABC assessment protocols in classification of motor impaired children as well as children with movement difficulties. It also underlined the necessity to refer children, who fall into this category, for further specialized assessment and guidance. It also implicated that it is not recommended to diagnose motor impairment from a single movement skill performance test (Foulder-Hughes and Cooke, 2003).

This result furthermore supported the premise that motor behavior is not a unitary theme and may refer back to Fleishman's work on the dimensions of human movement tasks (Fleishman, 1978). He classified movement skill proficiency in smaller categories, as motor ability is too broad as a category in his opinion. Factor analysis revealed factor loadings for a specific movement skill task in multiple ability categories (Hempel and Fleishman, 1955). The idea that motor skill proficiency consists of various uncorrelated factors was also supported by the results of this study. In addition, balance tasks frequently generate incomparable test results (Geuze, 2003; Netelenbos, 2001). This implicates that general motor skill scores used to express motor performance will always depend on the type of balance skills that are included in the task. Absence of significant correlation coefficients between different balance skill tasks in this study supported this finding. As shown in table 5, the patterns of correlation on item and subscale level in general did not provide support for the existence of a general motor ability factor. These observations support findings of earlier studies comparing different motor assessment tools (e.g. Smits-Engelsman et al., 1998).

A moderately strong correlation coefficient between the MOT 4-6's and M-ABC's total test scores necessitate caution when interpreting assessment results. High agreement on classification of children above the cut-off for motor difficulties implies that the MOT 4-6 can be considered a suitable tool to examine a child's movement skill level when the children have a typical developmental pattern. The differences found in this study were mainly attributed to limited correlation on item level, which represented task dependency of test performance. This was most explicit for balance skill tasks. The limited correlation with the object control subscale, may also be due to the limited number of items. Increasing the number and variety of object control tasks may enhance the protocols value. For that reason, Netelenbos (2001) underlined the importance of including a sufficient number of test items from each movement skill area when examining children's movement skill performance. Furthermore, it would be meaningful to further examine the identification power of the MOT 4-6 in a sample of children with suspected or already diagnosed motor difficulties.

The results of this study underline that limitations of the MOT 4-6 test were equal to those of the M-ABC and other similar tests. Additionally, the difficulty for tests to include the whole spectrum of the motor domain is a restraining factor and requires awareness that results rely on the movement tasks included in the respective test. The findings in this study supported the relevance of the factor 'task constraint' in Newell's model (Newell, 1985) on motor behavior and underline the importance of using the same task performance results when comparing children's motor performance.

Conclusion

High classification agreement existed between the MOT 4-6 and the M-ABC. Additionally, moderately strong correlation coefficients between the MOT 4-6's and the M-ABC's test scores supported convergent validity between the tests and provided evidence to consider the MOT 4-6 of equal value in the range of motor tests. The remarks on the validity of the movement skill tasks that

have been expressed for the M-ABC test, also apply for the MOT 4-6 test. However, as pointed out earlier the MOT 4-6 has high test efficiency primarily due to the number of tested items and the test time required to complete the assessment. It may therefore be preferred over the M-ABC to assess movement skill competence in typically developing preschool children. The use of a composite score to express a child's motor competence was found to depend on the movement skill tasks included in the tests. Therefore, it was suggested to label and organize skill sets within the assessment according to functions in movement skill competence studies as well as to consider individual task performances of young children. The identification disagreement of motor impairment implies that single test use of the MOT 4-6 to diagnose motor impairment in children is not recommended.

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Key points

- The Motoriktest für Vier- bis Sechsjährige Kinder (MOT 4-6) showed values within the range of similar motor performance tests. Because of its specific focus it may be of great value to assess movement skill competence in typically developing preschool children (ages 4 to 6).
- Children's movement skill competence can be expressed as a single composite score. The results from this study also support the use of composite scores that include functional categorization (e.g. locomotion, object control and stability).

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