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Postprint

This is the accepted version of a paper published in *Measurement in Physical Education and Exercise Science*. This paper has been peer-reviewed but does not include the final publisher proof-corrections or journal pagination.

Citation for the original published paper (version of record):

Tidén, A., Lundqvist, C., Nyberg, M. (2015)

Development and Initial Validation of the NyTid Test: A Movement Assessment Tool for Compulsory School Pupils.

Measurement in Physical Education and Exercise Science, 19(1): 34-43

<http://dx.doi.org/10.1080/1091367X.2014.975228>

Access to the published version may require subscription.

N.B. When citing this work, cite the original published paper.

Permanent link to this version:

<http://urn.kb.se/resolve?urn=urn:nbn:se:gih:diva-3746>

Development and Initial Validation of the NyTid Test: A Movement Assessment Tool for
Compulsory School Pupils

Abstract

This study presents the development process and initial validation of The NyTid test, a process-oriented movement assessment tool for compulsory school pupils. A sample of 1260 (627 girls and 633 boys; mean age of 14.39) Swedish school children participated in the study. In the first step, exploratory factor analyses (EFA) were performed in Sample 1, consisting of one third of the participants. The EFA indicated that the 17 skills in the test could be reduced to 12 and divided into four factors. In the second step, the suggested factor structure was cross-validated with confirmatory factor analyses (CFA) in the larger Sample 2. The NyTid test adopts a holistic perspective in which qualitative criteria offer an alternative approach to product-oriented measurement. The study confirms that the NyTid test is a valid process-oriented assessment tool designed for typically developed children aged 12 and 16.

Keywords: process-oriented assessment, movement development, movement skills, confirmatory factor analyses, the NyTid test

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Introduction

Movement competence has been discussed as an important component for children's engagement in physical activity and sports (Barnett, van Beurden, Morgan, Brooks, & Beard, 2009; Okely, Booth, & Patterson, 2001; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006). Movement competency has also proved to be important in terms of the physical fitness of children (Haga, 2008), adolescents (Hands, Larkin, Parker, Straker, & Perry, 2009) and young adults (Stodden, Langendorfer, & Robertson, 2009). Movement competence can generally be described as the ability to use voluntary movements in order to achieve a specific purpose or goal (Magill, 2011). Consequently, movement competence includes motor skills and physical capacities, such as the strength, flexibility, agility and fitness to perform different movement skills. As children usually value being good at sport, play and other physical activities, movement competence is an important field of study. It also plays a vital role in the concept of self-development (Gallahue & Ozmun, 1998). In this article we focus on the movement competence required in a physical education (PE) context.

To study children's and adolescents' movement competence, there is a need for adequate assessment tools. An extensive number of movement skill assessment tools have been developed over the years (e.g., Burton & Miller, 1998), but the availability of assessment tools for older children and adolescents is scarce. Many of the movement tests are aimed at a specific target group and hence have a specific content (e.g., Burton & Miller, 1998; Cools, De Marteleer, Samaey, & Andries, 2009), and most of these tools are developed for clinical use with the intention to identify children with motor impairment or medical deficits. Other tests are developed to identify children who are behind their peers and to plan for instructional programs, for example the TGMD-2 (Ulrich, 2000) and some tests have the purpose of

monitoring and following the development of children who have difficulty in reaching the stipulated learning outcomes in PE regarding fundamental movement skills (e.g.,

Fundamental Motor Skills: A Manual for Classroom Teachers (Department of Education, Victoria, 1996).

To assess and follow the movement competence in healthy and typically developed older children and adolescents, the NyTid test (Nyberg & Tidén, 2006) was created. One intention of the test was to examine movement skill competence among Swedish school pupils aged between 12 and 16. Another intention was to gather reference data for the specific age groups to make it possible to compare cross-sectional data and conduct longitudinal studies in the future. At the onset of the development of the NyTid test and data collection for the study, the Swedish curricula for Physical Education and Health (PEH) had as one standard of attainment for pupils aged 11 to 12 years: pupils should be able to manage basic motor activities and perform movements with balance and body control, as well as be able to perform simple dances and movement to music. For pupils aged 15 to 16 years the standard of attainment was formulated as follows: pupils should be able to participate in games, dance, sports and other activities and be able to perform movements appropriate to a task (SNAE, 2000). In this article, the aim is to validate the NyTid test by using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

Background

Several studies have examined movement skill competence in healthy and typically developing children, but the tests used were mainly developed for other purposes. These studies are adequately done, but questions can be raised concerning the choice of evaluation methods, for example the tests used. Limitations regarding tests of movement competence have been addressed by Logan, Robinson, Rudisill, Wadsworth, and Morera (2014). They point out that tests measure different aspects and/or levels of motor competence and should

not be used interchangeably, which is sometimes the case. Haga (2008) investigated the relationship between motor competence and physical fitness in children aged 9-10 with the Movement Assessment Battery for Children (M-ABC). The purpose of this test is mainly to identify children with motor impairment (Henderson, Sugden, & Barnett, 2007). Another example is Hands with colleagues (2009), who investigated motor competence, physical activity, and health-related fitness in 14-year-old adolescents using the McCarron Assessment of Neuromuscular Development (MAND). The main purpose of this test is also to identify motor deficiencies (McCarron, 1997).

Moreover, in a number of studies conducted on adolescents and young adults, researchers have measured a limited number of movement skills (Stodden, et al. 2009; Jaakkola, Kalaja, Liukkonen, Jutila, & Virtanen, 2009). These assessments have all been product-oriented. A number of shortcomings with product-oriented assessment have been addressed in the literature, including the problems of measuring quantitative aspects such as speed, height, length, or number of failed attempts. A product-oriented test score often reveals low ecological validity with regard to an individual's ability to execute the tested movement skill in a broader range of physical activities (Stodden, Goodway, Langendorfer, Robertson, Rudisill, Garcia, & Garcia, 2008). Another problem is that the movement process that precedes the result is disregarded; we get no or limited knowledge about the child's movement development (Stodden et al., 2008).

Questions regarding sport and gender bias in relation to assessment of children's movement competence have also been discussed by scholars (Larsson & Quennerstedt, 2012; Smith, 2011; Okely & Wright, 1997). As stated by Smith (2011), concepts of learning and performing movement skills need to include a sociological framework since a movement skill is as much a social as a physical act. The complexity of the learning context plays a crucial

part in how movement skills are learned and performed (Smith, 2011) and that should also be taken into consideration when movements are assessed and when interpreting the results.

To meet some of the above-mentioned aspects and as an alternative to the tests developed for children in their early years or for children with special needs, the NyTid test (Nyberg & Tidén, 2006) was created. The NyTid test is process-oriented and assesses the quality of movement skills in typically developed children and adolescents from a holistic perspective. The holistic perspective is characterized by the assessment of the overall execution of a movement skill and describing it in words, such as rhythm, balance, accuracy, efficiency and control, and not splitting the movement skills into isolated technical components. The intention is that the assessed skills should be sport- and gender-neutral. The aim of the test is that it should be suitable as an assessment tool and a pedagogical instrument for assessment for learning in PE. The test was developed in Sweden and may be most appropriate in a context in which PE has similar curricular goals to attain. If the focus is put on children's movement competences from a holistic perspective, the NyTid test could serve as a model for the development of new process-oriented movement assessment tools in any region. However, the test has to be adjusted to the PE context encountered by the pupils. The purpose of this study is to perform an initial evaluation and a cross-validation of the structural validity of the NyTid test by exploratory (EFA) and confirmatory factor analysis (CFA).

Method

Development and Description of the NyTid Test

The development of the test was part of a large-scale multidisciplinary Swedish school sports and health study (SIH). This study was a joint project between The Swedish School of Sport and Health Sciences, Stockholm University, and The Karolinska Institute. The overall study was designed by a research group of 15 professors and professionals with broad

experience in sport pedagogy, sport physiology, physical education, and physical education teacher training (Engström, 2004). To examine movement competence among pupils, the research group developed a movement test for compulsory school pupils aged between 12 and 16 (school years 6 and 9). A team of six members from the research group with special knowledge in children's movement development, kinetics, and biomechanics was responsible for the development of the NyTid test. The NyTid test was designed to develop a tool to assess a versatile movement repertoire including basic and more complex movement skills. In the first step, a review of several tests and assessment tools previously used in research and educational environments was conducted (Nyberg & Tidén, 2006). Four important concerns were identified: (a), characteristics and number of skills; (b), evaluation method, measurement and/or observation; (c), duration and implementation of the assessment procedure; and (d) validity and reliability of the test.

The NyTid test is grounded in existing theories of children's movement development (Clark, 2005, Gabbard, 2004; Gallahue & Ozmun, 1998). Movement development can be understood as a continuum with transitions of a number of developmental phases over time (Gabbard, 2004; Gallahue & Ozmun, 1998). The first phase, the reflex phase, includes reflex movements (e.g., grasping, tonic neck reflexes, and crawling) and is followed by the acquisition of movement skills in the rudimentary phase (e.g., rolling, creeping, standing, and walking). The child's repertoire of movement skills expands from about the age of 2 to 7 to include fundamental movement skills (FMS) in the next phase (e.g., Gabbard, 2004; Gallahue & Ozmun, 1998). The FMS are often divided into the following categories: (1) locomotor (e.g., walking, running, and jumping); (2) stability (e.g., dynamic and static balance and axial movements like twisting, turning, and rolling); and (3) object control skills (e.g., throwing, catching, and kicking) (Gabbard, 2004; Gallahue & Ozmun, 1998). In the following phase, the growth and refinement phase, which ranges from approximately 7 to 17 years of age, the

movements become more complex and are characterized by combinations and elaborations of the FMS applicable to a variety of activities for daily living, sports, and recreation (Gabbard, 2004; Gallahue & Ozmun, 1998). Another starting point has been Clark's (2005) developmental perspective on movement and mobility, which suggests that similar phases should not be age-determined or empirically proved. Instead, developmental phases should be seen as heuristic devices that assist the conceptualization of the vast changes that occur across the lifespan (Clark, 2005). With this in mind, the principles for selection of the skills were that they should represent a variety of movement skills involving rolling, rotating, turning, crawling, catching, throwing, jumping, hopping, running, grasping, dribbling, and their combinations. An important ambition was to adjust the complex and combined movement skills to suit the target age of the pupils. It was also intended that the skills should represent a broad movement repertoire (see Appendix A). Obtainable process-oriented assessment tools were examined including the TGMD-2, (Ulrich, 2000) and *Fundamental Motor Skills: A Manual for Classroom Teachers* (Department of Education, Victoria, 1996). We also examined review articles (e.g., Cools et al., 2009) and literature regarding the assessment of movement skills (e.g., Burton & Miller, 1998). Furthermore, a number of selected movement skills in already obtainable tests have been remodeled in terms of process-oriented assessment, target age, and context (e.g., throwing, dribbling, balanced beam walking, hopping and jumping). Other movement skills have been chosen because they consist of combinations of single skills such as skin the cat, swing on a rope and rope skipping. An important intention was that the children should not feel uncomfortable or labeled as "not good enough" during assessment. The pupils were to have a good experience and to become curious of learning more when they had completed the test. To fulfill these pedagogical intentions, the NyTid test involves process-oriented assessment of single movement and more complex combinations of movements. The team also discussed whether dance or rhythmic

movements to music should be included in the test, especially with regard to the importance of meeting the objective of versatility of movement skills in the test. However, the team found this too difficult to arrange without disturbing the assessment situation. The assessment situation was planned to resemble a possible regular Swedish PE lesson. The original test consists of 17 movement skills.

Two pilot studies were conducted prior to the study. One part of a combined movement skill was excluded from the proposed/original test, namely to jump down from the balance beam after the beam walk, because it was difficult to adequately assess that part of the movement skill. Minor changes regarding the test procedure and the arrangement in the gymnasium were also made (e.g., the size of the group tested together and the organization of test leaders). The decision was made to use one as the evaluator and one as the demonstrator of the different movement tasks. The test administrators evaluated the movement's execution level by using written criteria of a four-point scale with qualitative descriptions of each level. The criteria were based on movement development descriptions by Gallahue and Ozmun (1998) and the skill-learning process by Schmidt and Wrisberg (2000). Every skill has its own assessment criterion but can also be described at an aggregated level. Generally, the criterion is described as follows: Initial (1 point): the movement is slow, timid, and imbalanced; the movement pattern is slightly rigid, less controlled, and less adaptable; Emerging (2 points): the movement is more decisive and efficient, with a lack of rhythm and balance; the movement pattern is inefficient; Developed (3 points): the movement is more relaxed, with rhythm, balance, strength, and consistency; the movement pattern is more efficient; Proficient/Established (4 points): the movement is relaxed and performed confidently, rhythmically, accurately, and with balance; and the movement pattern is fluent, stable, and efficient (see Appendix B). A similar approach using the process-oriented assessment is applied in TGMD-2 (Ulrich, 2000) and in *Fundamental Motor Skills: A Manual for*

Classroom Teachers (Department of Education, Victoria, 1996). The NyTid test provides a holistic view, in comparison with TGMD-2 and the FMS manual which assess a number of technical components in the chosen movement skills.

Participants

With the assistance of Statistics Sweden, compulsory schools with the school years 3, 6, and 9 were randomly selected from a register containing all public schools in Sweden. In a second step, a stratified random selection was employed to obtain a comparable number of pupils representing different school years. A total of 58 schools in rural and urban areas all over the country were contacted. Those schools who declined ($n = 10$) did so due to logistical constraints and other circumstances (e.g., small countryside schools with only two to seven pupils meeting the inclusive age area) ($n = 6$), or social service schools pupils only attended temporarily ($n = 2$). The total number of schools that took part in the SIH study was 48. The sample in the movement skill study represented school years 6 and 9 and consisted of 1260 Swedish school children (627 girls and 633 boys; mean age of 14.39 ($SD = 1.52$)). The participants represent different cultural and socioeconomic backgrounds. Prior to the data collection, written informed consent was obtained from the participants' parents or guardians. The participants were notified that they could choose not to take part or could leave the assessment procedure at any time. The study was approved by the Ethical Committee at The Karolinska Institute (ref. no. 00-416).

Procedures

The study took place at three test sites (university gymnasiums) in Stockholm, Malmo, and Gothenburg. The participating schools could choose which test site they would attend and travel expenses were paid for by the project. The test process was conducted by teams consisting of at least one researcher and six test leaders. All test leaders had experience with teaching sports as well as physical education in schools and attended higher education in

human movement studies, kinetics, and sport science. They were all trained by the authors/developers of the NyTid test to instruct and assess according to the different criterion of the skills. Training sessions included discussions, watching video recordings of the skills, and written material. The test leaders also practiced how to demonstrate and give verbal instructions. Inter-rater reliability was checked and discussed by the evaluators and the authors/developers of the test, but was not calculated in terms of percentages. All the test leaders accepted as evaluators to administer the NyTid test had verified earlier knowledge and experience in physical education, sport and training.

The testing procedure took the whole group of approximately twenty pupils 45 to 60 minutes to complete. It began with 5-8-minutes of warming-up exercises. Groups of 5 to 7 pupils were tested together with three groups at the same time in order to eliminate waiting and watching. The three parts were composed due to environmental possibilities and logistical constraints in the gymnasium. When introducing the movement skills for the participants, one of the test leaders physically and verbally demonstrated the movement skills to be assessed. The test leaders worked in teams of one as a demonstrator and one as evaluator. The participants had one attempt at the basic skills (7 skills) and two attempts at more complex and combined movement skills (10 skills) so they could adjust speed and force. The highest score was recorded. If a participant misunderstood the instructions for the skill, he or she was allowed a second attempt. The pupils were able to ask the test leaders for support if they felt insecure performing “skin the cat” and “handstand”, and in that way avoided injury if they were unfamiliar with the movement skill or lacked the capacity to fulfill it. The pupils also had the option of not performing a movement skill if they felt uncomfortable or insecure.

Statistical Analysis

The data were first screened for missing values. Seventy-three children (34 girls, 39 boys) did not perform one or more skills in the test because of injury, illness, or lack of time

to participate. All participants with incomplete test results were excluded from further analysis. The remaining data were randomly split into two samples by use of SPSS 17.0. Approximately one-third of the participants were included in Sample 1 ($n = 411$, 212 girls and 199 boys) and the remaining participants were included in Sample 2 ($n = 776$, 381 girls and 395 boys). Chi-square analysis confirmed that boys and girls were equally distributed ($\chi^2(1) = .66, p = \text{n.s.}$) and an independent sample t-test showed no differences in age ($t(1185) = .43, p = \text{n.s.}$). Mahalanobis distance ($p < .001$) revealed no multivariate outliers in the various samples. The assumption of normality of the data was examined using skewness (Sample 1: range = $-.56 - .63$; Sample 2: range = $-.63 - .59$) and kurtosis (Sample 1: range = $-1.11 - .70$; Sample 2: range = $-1.10 - .53$).

In the first step of the analysis, an exploratory factor analysis of the original 17 skills was performed in Sample 1 using maximum likelihood extraction and varimax rotation. In the second step, the suggested factor structure was cross-validated with confirmatory factor analysis (CFA) in the larger Sample 2 using EQS 6.1 software (Bentler, 2006). This was done by performing CFAs using maximum likelihood estimation. Normalized estimates of Mardia's coefficient were nonsignificant (< 5 ; Bentler, 2006). The model fit was evaluated by means of the chi-square value (χ^2); the comparative fit index (CFI); the nonnormed fit index (NNFI); the root-mean-square error of approximation (RMSEA), which also includes a 90% confidence interval; and the standardized root-mean-square approximation (SRMR). A small and nonsignificant χ^2 indicates a good model fit, but is also highly sensitive to sample size (Bollen, 1989). The CFI and NNFI indicate a reasonable fit at a value of .90 and a close fit at values .95 or above (Hu & Bentler, 1999; Tabachnick & Fidell, 2007). Concerning the RMSEA and the SRMR, values close to or less than .06 and .08 respectively indicate a good fit (Browne & Cudek, 1993; Hu & Bentler, 1998, 1999). Internal consistency in terms of Cronbach's alpha was estimated by use of SPSS 17.0.

Results

Exploratory Factor Analysis in Sample 1

Both Bartlett's test of sphericity ($p < .001$) and the Kaiser-Meyer-Olkin measure of sampling adequacy (.86) suggested adequate factorability of the data. An examination of the eigenvalues, factor loadings, and the scree plot indicated that the 17 skills could be reduced to four factors, which together accounted for 41.50% of the variance (Factor 1 = 14.59%, Factor 2 = 9.80%, Factor 3 = 8.71%, Factor 4 = 8.39%). An inspection of the varimax-rotated factor loadings, shown in Table 1, revealed that three skills (roll sideways, crawling, and underhand throw) displayed insufficient factor loadings ($< .32$; Tabachnick & Fidell, 2007) and were weak skills. Five skills displayed double loading onto more than one factor. When the content of these skills was scrutinized, the loadings of the skills building a roof and sideways jump were deemed too difficult to motivate conceptually when related to the content in other skills loading onto the same factors. The skill skin the cat had fair loadings onto Factors 1 and 2, but appeared conceptually to be related to other skills in Factor 1. Dribble course loaded on Factors 3 and 4 but was judged to conceptually relate to Factor 3. Finally, the skill rope skipping had the highest factor loading onto Factor 4, and this loading could also be justified based on the content of the related skills that loaded onto that factor. Based on the EFA, it was decided that 12 of the 17 skills were to be retained for further analysis, and based on the content of the skills, the four factors were labeled: (1) strength and coordination skills; (2) stability and axial movement skills; (3) object control skills; and (4) dynamic balance and coordination skills (see Appendix A).

(Indication, Table 1. Factor loadings using an EFA in Sample 1 ($n = 411$). Tasks with factor loadings $< .32$ excluded)

Confirmatory Factor Analysis in Sample 2

According to Byrne's formula (2006), the four-factor model which was hypothesized to be correlated was overidentified because the 12 observed variables provided 78 data points and 30 parameters were specified to be estimated. Although the chi-square was significant ($\chi^2(48) = 234.43, p < .001$), the fit indices of the CFI ($= .93$), NNFI ($= .90$), SRMR ($= .06$) and the RMSEA ($= .07$, CI: $.06 - .08$), indicated an adequate model fit. As shown in Table 2, the standardized solution for factor loadings (range: $.51 - .78$), error variances (range: $.39 - .74$), explained variance (R^2 , range: $.26 - .61$) for the model and indicated that the 12 skills were adequate indicators of the latent factors. Finally, Cronbach's alpha scores were computed. The results revealed acceptable internal consistency for all factors (strength and coordination skills: $\alpha = .72$, stability and axial movement skills: $\alpha = .75$, and object control skills: $\alpha = .72$), but the factor dynamic balance and coordination skills showed a somewhat lower reliability ($\alpha = .56$).

(Indication, Table 2. Standardized solutions of the CFA of the correlated four-factor model (12 tasks) in Sample 2)

Discussion

Based on the results of the validation of the NyTid test, it is a promising tool. As such, it is an alternative to existing tests and to overcoming the shortage of assessment tools including more complex skills suitable for children aged between 12 and 16. It is thus possible to use the test to examine movement skill competence among school pupils. The baseline data gathered could be used to compare cross-sectional data and longitudinal studies in the future.

In this section we discuss the outcomes of the study by revisiting the four important concerns formulated at the beginning of the construction of the test: characteristics and number of skills, evaluation method, duration of assessment, and validity and reliability. The

validation has reduced the number of assessed movement skills from 17 to 12 and has also shown how these 12 movement skills can be structured in movement categories. The reduced number of movement skills will limit the assessment procedure.

From the originally selected 17 movement skills, EFAs and CFAs supported a correlated four-factor structure, including 12 movement skills total. Moreover, the four-factor structure was evident among children aged 12 and 16, as shown by a good model fit to the data. The suggested four factors could be viewed as broader aspects of movement skills in the growth and refinement phase (Gabbard, 2004) and specialized movement phase (Gallahue & Ozmun, 1998) in relation to the already established basic movement categories of locomotor, object control, and stability skills in the fundamental movement skills (FMS) phase. The component of strength in Factor 1, here labeled strength and coordination skills, have in previous research shown to be related to good results in movement skill testing (e.g., Haga, 2008; Hands et al., 2009; Stodden et al., 2009; Thomas & French, 1985). A component of strength can be understood as an important part in movement skill development. Stability and axial movement skills (Factor 2) and dynamic balance and coordination skills (Factor 4) are closely related to the existing FMS categories stability and locomotor. However, in the NyTid test, the factors are assessed with skills designed to capture combinations of movement skills which are more sophisticated and complex. Object control skills (Factor 3) are included in accessible tests, including the TGMD-2 (Ulrich, 2000) and *Fundamental Motor Skills: A Manual for Classroom Teachers* (Department of Education, Victoria, 1996). In the NyTid test, this concept is further developed to encompass more complex movements like the skill “dribble course” and the skill “throwing with a run-up.” Thus, the new factors assessed in the NyTid test can be associated with movement skills in the growth and refinement phase (Gabbard, 2004) and can be discussed in relation to the assessment of movement skills in children aged 12 and 16.

Some limitations with the NyTid test detected in the analysis need to be addressed. The double loadings in the EFA are plausibly explained by the complexity of the movement skills as they encompass multilimb coordination, coordinating several limbs simultaneously (Magill, 2011). Due to the purpose of the NyTid test, to capture a broader perceptual of more advanced movement skills, it consists of combinations and elaborations of basic movement skills, which can explain some of the double loadings. Other assessment tools, such as the TGMD-2 (Ulrich, 2000), have shown similar difficulties, where double loadings were revealed for the skills strike (object control skill) and jump (locomotor skill) (Ulrich, 2000). Whereas the NyTid test aims to assess even more complex and combined skills than obtainable assessment tools, the increased complexity of the skills in this test presents an additional challenge in refining skills. Future research is warranted to further investigate whether some of the movement skills should be remodeled or replaced with others. For instance, factor 2 consists of two overhand throws; one of the throws could possibly be replaced with another object control skill or remodeled to become more complex.

In terms of the internal consistency, the reliability scores were shown as acceptable for three of the four factors despite each factor consisting of only a few movement skills. When the NyTid test was developed, a relatively short test with a variety of movement skills was viewed as desirable to facilitate its practical feasibility in school settings. A general difficulty with including only a few movement skills is the challenge it presents to statistically achieve high internal consistency. Factor 4, dynamic balance and coordination, revealed a somewhat lower internal consistency, which can be due to the previously discussed difficulties with double loadings and the low number of skills, but also the nature of the factor itself. The factor consists of two lower-body coordination skills, hops and jumps and walking the beam, and one whole body coordination skill, rope skipping. Thus, researchers and practitioners employing the NyTid test should be aware that the precision of the dynamic and coordination

factor may be lower than in the remaining factors. This needs to be taken into consideration when interpreting the test results.

Process-oriented assessment of more complex movement skills and combinations of movement skills inherently presents challenges because of having to combine separate skills. However, a qualitative holistic perspective has its limitations and its advantages. Such an assessment stresses the importance for test evaluators to have experience assessing movements and knowledge of movement development. It is also important to have received training in and practice with the NyTid test before using it. Despite some apparent limitations, the NyTid test is, to date, perhaps the only process-oriented assessment tool available to assess more complex movement skills and combinations of FMS in the growth and refinement phase for healthy and typically developed children. Questions concerning intra and inter rater reliability and proficiency levels among evaluators are important concerns when conducting qualitatively assessed research and need to be addressed in future applications of the instrument. Despite that, a further advantage of this study is the independent random selection of schools across Sweden and the large number of participants in the samples. The samples represent cross-sectional normative data of Swedish students' movement competence in two age groups. The NyTid test was developed in a Scandinavian gymnasium setting traditionally furnished with sports and gymnastic equipment. It should be noted that instruments like the NyTid test may be culturally biased and if they are used in a PE or PEH context the curricular focus will differ. Instruments should always be tested for cultural sensitivity before using them in new contexts, such as new regions and ethnic groups (Tripathi, Joshua, Kotian, & Telda, 2008). Thus, although the NyTid test is a promising assessment tool, future research should further investigate the NyTid test in relation to existing tests in the field and to explore areas of possible improvements to the validity and reliability of the assessment tool.

This study confirms that the NyTid test is a valid process-oriented assessment tool designed for typically developed children aged 12 and 16. The NyTid test adopts a holistic perspective in which qualitative criteria offer an alternative approach to product-oriented measurement. Process-oriented tests have mostly evaluated technical components of single movement skills and not in a holistic perspective. In this validation study, four new categories add a broader understanding of movement development in older children and adolescents. The test may also be used as formative assessment as well as guidance for PE teachers and coaches. In line with what Silverman, Keating, and Phillips (2008) suggest regarding the use of fitness tests as formative evaluation of educational goals, we would argue that the evaluation of movement skills can be approached in much the same way. The NyTid test, perhaps with the addition of movements involving music and rhythm (Okley & Wright, 1997) and movement skills in an outdoor environment, represents a versatile movement repertoire. Another future perspective could be to use the NyTid test in self and/or peer-assessment for learning. Therefore, the test is suggested as useful in a broader educational context to develop a versatile movement repertoire by using the criteria for each movement skill.

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Description of the 12 tasks in the revised NyTid test

Factor	Task	Function	Description
Factor 1: Strength (hand, shoulder, and abdominal) and coordination movement skills			
1	Hand walk on boxes	Body stability and shoulder strength	Hand walk on vaulting boxes, the length of the vaulting box, feet down
1	Skin the cat	Hang, grasp, rotate	Hang from the gymnastic rings and rotate backward and forward, touching the floor in-between
1	Swing on a rope	Hang, grasp, strength, Lift legs using hip flexors	Stand on a gymnastic bench and swing on a rope to a vaulting box
Factor 2: Stability and axial movement skills			
2	Forward roll	Roll and rotate	Forward roll to a standing position
2	Cartwheel	Rotate, stability, shoulder strength	Turn over sideways with arms and legs spread like the spokes of a wheel
2	Handstand	Rotate, stability, shoulder strength	Handstand using a wall as support
Factor 3: Object control skills			
3	Stationary overhand throw	Throw	Standing overhand throw at a wall
3	Throw with run-up	Throw	Overhand throw at a wall with run-up
3	Dribble course	Walk/run, dribble with hands, throw and catch on the run	Dribble with hands around a zigzag course, move clockwise around a cone, move anticlockwise around another, dribble, and throw and catch on the run
Factor 4: Dynamic balance and coordination skills			
4	Rope skipping	Jumping and running	Rope skipping (10 reps x 3 sets) Two-foot bounce, double two-foot bounce, and run
4	Hops and jumps	Hop and jump	Hop on the left foot 5 times, turn around, hop

			on the right foot 5 times, turn around, two-footed jump with legs apart, hop with one foot in each ring 5 times, turn around, hop with feet together in each hula hoop ring 5 times
4	Walk on beam	Dynamic balance	Walk forward and backward on a beam

Tasks excluded after EFA

- Roll sideways “like a log” on a gymnastic mat
- Build a roof—climb backwards to a handstand position against a wall
- Side vault—run-up, springboard take-off, side vault over a vaulting box, and a balanced landing
- Diagonal crawl on the floor
- Underhand throw with bean bags, precision throw into a hula hoop (10 bean bags)

Appendix B

Qualitative assessment criteria for different movement skills in the NyTid test, 4 examples

Factor	Initial (1 point)	Emerging (2 points)	Developed (3 points)	Proficient/ Established (4 points)	
General assessment criteria: the movement is . . .					
1-4	All movement skills	. . . slow, timid, and unbalanced. The movement pattern is slightly rigid, less controlled, and less adaptable.	. . . more decisive and efficient with a lack of rhythm and balance. The movement pattern is inefficient.	. . . more relaxed, with rhythm, balance, strength, and consistency. The movement pattern is more efficient.	. . . relaxed and performed confidently, rhythmically, accurately, and with balance. The movement pattern is fluent, stable, and efficient.
Factor	Movement skills	Examples of specific assessment criteria			
1	Skin the cat	Not enough strength and coordination to do the rotations. Afraid to do the task.	Rotates backward and forward. The movements are rigid and uneven.	Rotates backward and forward without difficulty.	Rotates rhythmically and accurately.
2	Forward roll	Difficulty doing a smooth roll, loses direction, and ends up in a sitting position.	Some difficulty doing a roll and uses one or two hands when standing up.	Easily performs a roll without losing direction and ends up in a standing position.	Performs the forward roll with ease and control.
3	Dribble course	Drops the ball, looks at the ball throughout the dribbling, and has an uncertain	Slow and with some uncertainty, mostly walks when dribbling the ball, and walks	Dribbles without difficulty and has some changes of direction. Able to	Changes dribbling hand, can look up from the ball, and has good speed and

		movement pattern. Stops when throwing and catching the ball.	when throwing and catching the ball.	throw and catch on the run.	rhythm.
4	Walking the beam	Walks slowly and hesitantly or falls/jumps down.	No difficulty walking forward and is cautious/ hesitant when walking backward.	Steady pace/speed and maintains balance when walking both forward and backward.	Walks forward and backward with great confidence and steady balance.
