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Abstract

The targeted continent and/or country driven promotion of physical activity and health from an early age onwards requires more insight into cross-cultural differences in motor competence. Using the Bruininks-Oseretsky Test of Motor Proficiency-2 Short Form (BOT-2 SF), this study assessed and compared both fine and gross motor skill performances of 5- and 6-year-old children from Belgium (n = 325) and Greece (n = 245). Linear mixed effect models and a χ^2 test analyzed between-country differences in BOT-2 SF scores and the distribution across descriptive performance categories. Overall, Belgian and Greek participants displayed quite similar levels of motor competence, with less children performing (well-)below average than could be expected. On test item level, however, several significant differences emerged. Large effect sizes were found for knee push-ups (Hedges' g = 1.46) and copying a square (Hedges' g = 2.59) demonstrating a better outcome for Belgian and Greek preschoolers, respectively. These findings might be attributed to different (physical) education practices in both European countries. The present study also highlights the importance of using an assessment tool covering the entire range of motor skills as well as a focusing primarily on raw performance scores, containing and explaining more variance, for international comparative research purposes.

Keywords: early childhood, preschool, motor skill assessment, Bruininks-Oseresky Test of Motor Proficiency, international comparison, cultural background

Motor Competence Levels in Young Children: A Cross-cultural Comparison between Belgium and Greece

Early childhood is an important period for human motor development because in these young years children acquire and refine a wide range of fundamental motor skills (Gallahue, Ozmun, & Goodway, 2012). A large amount of research supports that a child's level of motor competence (i.e., a performance related outcome reflecting the degree of proficiency in executing a broad array of both fine and gross motor skills) (Haga et al., 2018; Haywood & Getchell, 2014) is associated with several health indicators (Robinson et al., 2015), such as physical fitness (Cattuzzo et al., 2016; Haga, 2009; Lubans, Morgan, Cliff, Barnett, & Okely, 2010; Stodden et al., 2008), weight status (Cattuzzo et al., 2016; D'Hondt, Deforche, De Bourdeaudhuij, & Lenoir, 2009; D'Hondt et al., 2011; Lubans et al., 2010) and psychosocial well-being (Emck, Bosscher, Beek, & Doreleijers, 2009; Lingam et al., 2010; Piek, Barrett, Smith, Rigoli, & Gasson, 2010; Piek, Dawson, Smith, & Gasson, 2008). Furthermore, the critical role of motor competence for physical activity participation is well documented, both in the short (Castelli & Valley, 2007; Kambas et al., 2012; Okely, Booth, & Patterson, 2001) and the long term (Barnett, Van Beurden, Morgan, Brooks, & Beard, 2009; Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2010; Lloyd, Saunders, Bremer, & Tremblay, 2014; Lopes, Rodrigues, Maia, & Malina, 2011; Venetsanou & Kambas, 2017a). Nevertheless, a secular decline in motor competence levels has been reported in several recent studies (Bardid, Rudd, Lenoir, Polman, & Barnett, 2015; Bardid et al., 2016; Brian et al., 2018; Luz et al., 2019; Tester, Ackland, & Houghton, 2014; Vandorpe et al., 2011).

Since motor development is thought to be influenced by the cultural context as well as the social and physical environment in which children grow up (Venetsanou & Kambas, 2010), a better understanding of between-country differences in motor competence may contribute to more efficient interventions aiming at its enhancement with regard to health and well-being from an early age onwards. Unsurprisingly, a number of studies have demonstrated significant differences in motor skill performance when comparing motor competence profiles of children living in countries located in other continents across the globe (Bardid et al., 2015, 2016; Brian et al., 2018; Cepicka, 2010; Chow, Henderson, & Barnett, 2001; Ruiz, Graupera, Gutiérrez, & Miyahara, 2003; Saraiva, Rodrigues, Cordovil, & Barreiros, 2013; Tripathi, Joshua, Kotian, & Tedla, 2008). However, some studies also revealed various levels of motor competence when comparing children living in different but sometimes almost neighboring countries situated within the same continent and thus thought to have a quite similar (movement) culture (Haga et al., 2018; Niemeijer, van Waelvelde, & Smits-Engelsman, 2015).

These findings might be attributed to cross-cultural differences in educational systems and physical education policies (Bardid et al., 2015; Brian et al., 2018) as part of the outer layers of Bronfenbrenner's ecological model for child development (Bronfenbrenner, 1979). To begin with, a near universal enrolment (ranging from 98 to 100%) of 3- to 5-year-olds in preschool education is reported in some countries (e.g., United Kingdom, Israel, France and Belgium), whereas in others rates of children attending preschool are around 65% (e.g., United States and Greece) or even lower (e.g., Turkey [37%] and Saudi Arabia [25%]) (Organization for Economic Cooperation and Development [OECD], 2018). Moreover, there is a discrepancy across countries in preschool physical education practices. In Belgium, for example, young children receive physical education lessons in preschool as a regular part of the curriculum and many preschools also have trained physical educators on the staff (Brian et al., 2018; De Martelaer, Cools, Samaey, & Andries, 2007; Van Cauwenberghe, Labarque, Gubbels, De Bourdeaudhuij, & Cardon, 2012; van Waelvelde, Peersman, Lenoir, Smits-Engelsman, & Henderson, 2008). In other countries (e.g., United States [Brian et al., 2018] and Greece [Venetsanou & Kambas, 2017b]), however, preschoolers do not receive this structured opportunity for motor development. Such (physical) educational disparities should be taken into account when studying young children's motor competence levels across countries, especially since an increase of 10% in average school enrolment among 3- to 5-year-old children is currently reported (OECD, 2018). A recent study also demonstrated higher scores in both locomotor and object control skills in 4- to 5-year-old Belgian children receiving regular physical education compared to U.S. peers only receiving unstructured physical activity opportunities (Brian et al., 2018). Such evidence suggests that the development and level of motor competence benefits from supportive and structured learning environments (De Martelaer et al., 2007; Logan, Robinson, Wilson, & Lucas, 2012).

For an accurate assessment of actual motor competence, a psychometrically sound assessment tool should be administered which can either be process-oriented (i.e., evaluation of how movements are performed) or product-oriented (i.e., evaluation of the outcome of a movement) (Logan, Barnett, Goodway, & Stodden, 2017). Although many of such validated and reliable test batteries exist, they often measure discrete or different aspects of motor competence and no single motor skill assessment tool is being internationally recognized as the gold standard to date (Piek, Hands & Licari, 2012; Rudd et al., 2016). Furthermore, there tends to be a lack of agreement on which test battery is most suitable to specifically discover cross-cultural differences (Haga et al., 2018). This means that the choice for a particular assessment tool, with its distinct features, may determine whether as well as the extent to which differences in motor competence levels are established between various subsamples of children, such as when performing international comparisons. In several cross-cultural studies, well-known motor test batteries have been used. However, it should be noted that they often do not provide a complete picture of children's motor competence level. For example, some studies (Bardid et al., 2016; Brian et al., 2018) worked with the Test of Gross Motor Development, 2nd Edition (TGMD-2; Ulrich, 2000), assessing locomotor and object control skills but not stability and fine motor skills; whereas others (Bardid et al., 2015) made use of the KörperKoordinations Test für Kinder (KTK; Kiphard & Schilling, 1974, 2007), focusing on gross motor coordination but not evaluating any object control or fine motor skills.

Accordingly, the Short Form of the Bruininks-Oseretsky Test of Motor proficiency-2 (BOT-2 SF; Bruininks & Bruininks, 2005) presents itself as an optimal tool for examining cross-cultural differences between countries (both across and within continents). The BOT-2 SF provides a comprehensive picture of motor competence by covering the whole spectrum from fine to gross motor skills with its separate test items. Moreover, this widespread screening tool has been extensively used both in populations with special needs (Berg, Becker, Martian, Primrose, & Wingen, 2012; Smith et al., 2013) as well as typical development (Chowdhury, Wrotniak, & Ghosh, 2010; Nunez-Gaunaurd, Moore, Roach, Miller, & Kirk-Sanchez, 2013). The BOT-2 SF test protocol is also easy to administer, not very time consuming and generally enjoyed by children when performing the motor skill tasks involved.

Considering the importance of motor competence for (lifelong) physical activity participation and daily functioning (Gallahue et al., 2012), its assessment in early childhood years seems imperative. Moreover, comparing motor competence levels in children from various countries with an assessment tool that provides a broad picture of both fine and gross motor skill performance may offer valuable information towards a more comprehensive understanding of potential differences, specifically linked to their cultural background and educational system. Hence, the primary aim of this cross-cultural study was to examine and compare the level of motor competence among 5- and 6-year-old boys and girls living in Belgium and Greece, which are two geographically spread countries within the same continent having different (physical) education practices in preschool. Using the BOT-2 SF, this study also aimed at comparing the distribution of both Belgian and Greek preschoolers across the distinguished performance categories and against the expected distribution based on the original U.S. normative sample.

Methods

Participants

A total of 571 children, aged 5 to 6 years (i.e., ranging from 70 to 83 months), participated in this cross-sectional study pooling BOT-2 SF data collected in two different European countries. Among these participants, 325 were from Belgium (77.9 ± 3.8 months, 45.2% boys) and 246 from Greece (72.9 ± 3.1 months, 45.9% boys). To ensure representative subsamples in both countries, a stratified cluster sampling of schools for general education was used based upon region (i.e., province or prefecture) combining both urban and rural areas. In Belgium, children were recruited from schools located in all five Flemish provinces (i.e., West-Vlaanderen, Oost-Vlaanderen, Antwerpen, Vlaams-Brabant, Limburg) and the Brussels Capital Region. In Greece, children were recruited from schools in five different prefectures from the mainland (i.e., Attica, Argolida, Aitoloakarnania, Rodopi, Kavala). In both countries, children diagnosed with a known disability affecting motor competence (e.g., autism spectrum disorders, cerebral palsy, developmental coordination disorder, mental retardation) were excluded from this study focusing on typically (motor) developing children in the nonclinical population.

Written informed consent was obtained from the parent(s) or legal caretaker(s) of all participants. The study also received approval from the local institutional review boards in Belgium and Greece.

Procedure and Measurements

All assessments were conducted in an indoor facility, with participants wearing light clothes and being barefooted when performing the tests. Height and weight were assessed first. Subsequently, children's level of motor competence was tested individually by master and doctoral students in Physical Education, who were specifically trained to administer the BOT-2 SF test battery according to the manual guidelines (Bruininks & Bruininks, 2005). Altogether, the anthropometric measurements combined with the BOT-2 SF test administration took approximately 20 min per participant to be completed.

Anthropometry. In the Belgian subsample, height was measured to the nearest 0.1 cm with a portable stadiometer (Harpenden, Holtain, United Kingdom), whereas body weight was measured with an accuracy of 0.1 kg using a digital balance scale (Tanita, BC420-SMA, Japan). In Greek children, height and weight were recorded with using a Stadiometer 208 (Seca, United Kingdom) and a Beam Balance 710 (Seca, United Kingdom), respectively. From both measures, all participants' body mass index (BMI, in kg/m^2) was calculated. In addition, their weight status (i.e., healthy-weight, overweight, obese) was defined according to the age- and sex-specific BMI cut-off values for children of the International Obesity Task Force (IOTF; Cole, Bellizzi, Flegal, & Dietz, 2000).

Motor competence. To assess their level of motor competence when performing both fine and gross motor skill tasks, all participants completed the Short Form of the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2 SF; Bruininks & Bruininks, 2005). The BOT-2 SF consists of 14 individual test items from eight separate subtests representing four overarching motor constructs (see Table 1 for an overview). Children's performance on the BOT-2 SF test items was recorded as a raw performance score (e.g., time needed to complete a task, number of correct executions of the skill, number of errors). Applying the BOT-2 SF scoring system, these raw scores were converted into item point scores to evaluate performance on a graded scale. By adding these 14 point scores together, a total point score (ranging between 0 and 88) for the entire BOT-2 SF was provided. Using the highly recommended age- and sex-specific normative tables derived from the original U.S. reference sample (Bruininks & Bruininks, 2005; Deitz, Kartin, & Kopp, 2007), the total point score for the BOT-2 SF was converted into an overall standard score. The percentile rank of this normative standard score is commonly used for classification purposes across descriptive performance categories (i.e. "well-below average", "below average", "average", "above average" and "well-above average") and motor impairment screening on a global scale.

Within the 4 to 7 year of age category, the BOT-2 SF (including knee push-ups) shows high internal consistency reliability across its items, with a stratified alpha of .82, and very good test-retest reliability over a time interval of 7 to 35 days, with a correlation coefficient of .86. The interrater reliability for the whole age range is considered extremely high as demonstrated by a correlation coefficient of .98 (Bruininks & Bruininks, 2005). In terms of validity, it has been shown that the BOT-2 SF correlates high (r = .80) with the BOT-2 Complete Form (Bruininks & Bruininks, 2005; Deitz et al., 2007), whereas a moderately strong positive association (r = .61) was found between the BOT-2 SF total point score and the total Motor Quotient (MQ) of the KörperkoordinationsTest für Kinder (KTK) (Fransen et al., 2014).

Data Analysis

Descriptive statistics were calculated for anthropometric measures (i.e., height, weight, and BMI) and all BOT-2 SF test outcomes (i.e., 14 raw performance scores, the total point score, and the normative standard score) using the R-package 'pastecs' (version 1.3.21) (Grosjean, Ibanez, & Etienne, 2018). To account for the clustered data structure (i.e. children nested within schools in different regions), 'school' (n = 37) and 'region' (n = 11) were included as random effects in all multilevel statistical models. Differences by sex and country (i.e. fixed effects) in anthropometric measures as well as BOT-2 SF raw performance scores and the total point score were tested corrected for age (in months) using linear mixed effects models, including the sex*country interaction term. Significant interaction effects were split by sex in order to further investigate the between-country differences using the same linear mixed effects models. The normative standard score, which is an age- and sex-specific test outcome of the BOT-2 SF, was analyzed using a linear mixed effects model with only country as a fixed factor. Finally, a χ^2 test was used to compare the distributions of Belgian and Greek children across the BOT-2 SF descriptive performance categories.

All analyses were performed in R (version 3.5.2) in the package 'nlme' (version 3.1-137) (Pinheiro, Bates, DebRoy, Sakar, & R Core Team, 2018), with p values < .05 considered as statistically significant and p values < .10 as a trend. In addition to these p values, effect sizes as measured by Hedges' g (for the multilevel analysis' main effects) and φ_c values (for the χ^2 analysis) were also calculated. Following Cohen's (1988) guidelines, the magnitude of effect sizes was considered small (Hedges' $g \geq .20$, $\varphi_c \geq .10$), medium (Hedges' $g \geq .50$, $\varphi_c \geq .30$) or large (Hedges' $g \geq .80$, $\varphi_c \geq .50$).

Results

Anthropometry

The descriptive statistics of all anthropometric measures are displayed in Table 2. No significant interaction or main effects were observed. In comparison to the Belgian subsample, however, the Greek children tended to be somewhat taller ($t_{country}$ = 1.866, p =

.095, Hedges' g = .02; Belgium: 119.5 ± 5.4 cm, Greece: 119.6 ± 6.2 cm) and heavier ($t_{country}$ = 2.133, p = .062, Hedges' g = .21; Belgium: 22.7 ± 3.7 kg, Greece: 23.5 ± 4.5 kg). Yet, a higher proportion of the Greek subsample was found to be overweight (16.3%) or obese (7.8%) compared to the Belgian one (overweight: 11.1%, obese: 2.2%; χ^2 = 14.499, p = .001, φ_c = .159).

Motor Competence

The descriptive statistics of all BOT-2 SF test outcomes (i.e., 14 raw performance scores, the total point score, and the normative standard score) are displayed in Table 3.

Raw performance scores. Mean between-country differences in raw performance scores on the BOT-2 SF test items are displayed in Figure 1. A significant country by sex interaction effect was present for two test items. First, the walking forward on a line performance ($t_{sex*country}$ = 2.081, p = .038) was found to be better in Greek boys when compared to their Belgian counterparts ($t_{country}$ = 2.380, p = .041, Hedges' g = .36), while there was no significant between-country difference among girls. Second, for the one-legged stationary hop test ($t_{sex*country}$ = 2.810, p = .005), Belgian boys displayed a higher performance than their Greek counterparts ($t_{country}$ = 4.137, p = .003, Hedges' g = .90), with a similar between-country trend found in girls ($t_{country}$ = 2.163, p = .058, Hedges' g = .47). In addition, a significant main effect of country was present for seven and thus half of the 14 individual test items. Greek children obtained higher raw performance scores when compared to the Belgian subsample for copying a square ($t_{country}$ = 10.081, p < .001, Hedges' g = 2.59; Belgium: 2.52 ± 0.91, Greece: 4.76 ± 0.80), copying a star ($t_{country}$ = 3.785, p = .004, Hedges' g = .57; Belgium: 1.48 ± 1.17, Greece: 2.37 ± 1.97), tapping feet and fingers ($t_{country}$ = 3.910, p = .004, Hedges' g = .52; Belgium: 8.27 ± 2.86, Greece: 9.54 ± 1.70), and walking forward on a line ($t_{country}$ = 2.625, p = .028, Hedges' g = .19; Belgium: 5.81 ± 0.62, Greece: 5.92 ± 0.51). Belgian children showed better raw performance scores than those in the Greek subsample for dribbling a ball ($t_{country}$ = 3.153, p = .012, Hedges' g = .76; Belgium: 3.74 ± 2.38, Greece: 2.10 ± 1.85), one-legged stationary hop ($t_{country}$ = 4.353, p = .002, Hedges' g = .68; Belgium: 37.92 ± 7.41, Greece: 31.31 ± 12.24), and knee push-ups ($t_{country}$ = 5.235, p = .001, Hedges' g = 1.46; Belgium: 17.73 ± 5.67, Greece: 9.02 ± 6.31).

Total point score and normative standard score. No significant interaction effect as well as no between-country difference was found for the total point score of the BOT-2 SF ($t_{sex*country}$ = 0.174, p = .861; $t_{country}$ = 0.323, p = .754, Hedges' g = .30). Also for the age- and sex-specific normative standard score, the main effect of country was not found to be significant ($t_{country}$ = 1.767, p = .111, Hedges' g = .27).

Distribution across descriptive performance categories. The proportion of Belgian and Greek children across the BOT-2 SF descriptive performance categories is displayed in Figure 2. Because of the limited number of participants in the original two extreme categories, it was decided to combine them with the adjacent categories into a (well-)below average and a (well-)above average category, respectively. Using this latter classification, a significant difference in distribution was found between both countries (χ^2 = 8.116, p = .017, φ_c = .119). The proportion of children performing at an average level was higher in the Belgian versus the Greek subsample (△ = 7.31%), whereas a higher percentage of Greek children did perform (well-)above average (△ = 8.83%). In contrast, the proportion of children scoring (well-)below average was found to be comparable in both countries.

Discussion

Given the importance of children's motor competence for physical activity, health and well-being, it is essential to gain more insight into how motor skill development and performances depend on cultural context (not only across but also within different continents) with a tool assessing the entire range of both fine and gross motor skills. Using the BOT-2 SF, the purpose of this study was to examine cross-cultural differences in motor competence levels of young children aged 5 to 6 years from Belgium (i.e., Western Europe) and Greece (i.e., Southern Europe) as well as to compare the distribution of both countries across the distinguished performance categories and against the expected distribution based on the original U.S. normative sample.

Cross-cultural Comparison of Motor Competence Levels: Belgium versus Greece

According to their overall scores (i.e., BOT-2 SF total point and normative standard score), Belgian and Greek preschoolers had quite similar motor competence levels in general. However, when looking at the raw performance scores, several cross-cultural differences between both countries emerged on test item level. Greek children displayed significantly better scores on copying a square, copying a star, tapping feet and fingers, and (only in boys) walking forward on a line. Effect sizes ranged from small to medium for these test items, except for copying a square showing a very large effect size for the difference found. In turn, Belgian children significantly surpassed their Greek peers on dribbling a ball, the one-legged stationary hop test (with a slightly more pronounced between-country difference in boys) and when performing knee push-ups. In addition to medium effect sizes for the first two items, a large effect size was found for this latter test item only.

The distinctly better performance on knee push-ups of the Belgian participants might in part be attributed to lower prevalence rates of overweight and obesity when compared to the Greek subsample in our study. Previous research already established an inverse association between a greater body mass that has to be moved against gravity and children's performance on both endurance and weight-bearing tasks (Deforche et al., 2003; D'Hondt et al., 2009; Tokmakidis, Kasambalis, & Christodoulos, 2006).

On top of specific individual constraints, these findings can be interpreted to a larger extent by differences in the early childhood educational system of both countries as an environmental aspect (Bronfenbrenner, 1979) and more specifically the attention that is given to physical activities during school time. Bardid et al. (2016) stated that both structured and unstructured physical activities in the (pre)school setting considerably enable children to learn and develop their motor skills. In Greece, the rates of children attending preschool are on average 63%, while in Belgium the enrolment is almost total (OECD, 2018; van Waelvelde et al., 2018). In addition to this difference in preschool attendance rates, there is also a discrepancy between both countries in preschool educational practices. In contrast to Greece (Venetsanou & Kambas, 2017b), physical education is a fixed part of the Flemish curriculum in Belgium. In most cases, these structured opportunities for motor development are also provided by qualified physical education teachers (Brian et al., 2018; De Martelaer et al., 2007; Van Cauwenberghe et al., 2012; van Waelvelde et al., 2008). The significantly better BOT-2 SF performances on item level of the Belgian subsample can thus be explained by the fact they are exposed to a greater amount of (gross) motor skill exploration in preschool as well as a better health-related physical fitness from a young age onwards (Bardid et al., 2015; Brian et al., 2018). However, the significantly higher raw performance scores of Greek children, especially in the copying tasks evaluating fine motor integration, might point to other educational differences beyond physical education. In Greece, a great(er) emphasis is placed on preschool children's training in perceptual and graphomotor tasks. For instance, a child that enters Greek preschool at the age of 4 years in September is expected to be able to satisfactorily copy various shapes but also letters by the following month of May. In Belgium, preschool classes already start when a child is 2.5 years old and mainly involve play-like activities at first. The curriculum only becomes more formal later on. This also includes focused practice of graphic tasks (e.g., coloring and tracing) in preparation of the actual handwriting lessons, which start at 6 years of age (van Waelvelde et al., 2008).

Regarding the distribution across the descriptive performance categories of the BOT-2 SF, the summed proportion of children scoring at an average or (well-)above average level was somewhat higher than in the original U.S. reference sample (Bruininks & Bruininks, 2005). As such, the present findings do not confirm previous research reporting a decline in motor competence levels of today's children (Bardid et al., 2015, 2016; Brian et al., 2018; Luz et al., 2019; Tester et al., 2014; Vandorpe et al., 2011). It should be noted, however, that all of these studies used assessment tools or test batteries that exclusively measure (aspects of) fitness, gross motor skills and/or whole body coordination. Assessing fine and gross motor skill performances altogether, the present study did not notice a deterioration in the participating children's motor competence levels relative to the original BOT-2 SF reference standards. Similarly, van Waelvelde et al. (2008) found that Flemish children participating in their study had similar or sometimes even better performances compared to the U.S. normative sample of Movement Assessment Battery for Children (M-ABC; Henderson & Sugden, 1992), also covering the full range of both fine and gross motor skill tasks. These analogue findings suggest that a more complete picture of (secular trends in) children's motor competence is required. In the absence of an internationally excepted gold standard and/or global reference norms, each particular assessment tool thus sheds a different light on children's motor competence in the context of comparative research purposes, either from a time-bound or cross-cultural perspective.

Strengths and Limitations of the Present Study

A particular strength of this study was the use of the BOT-2 SF for assessing children's motor competence, given that this tool evaluates performance on tasks covering the whole spectrum from fine to gross motor skills. Moreover, the use of a multilevel statistical approach to account for our hierarchical data structure enabled us to present more sound results compared to the analyses of variance methods commonly applied in the motor development literature.

Nevertheless, some limitations should also be acknowledged for an adequate interpretation of our findings. First of all, both subsamples included in this cross-sectional study were not equal in size and participants were not matched one-on-one. Although children from preschools across different regions within each country were selected using stratified cluster sampling, population based random sampling would have benefited the external validity of our study even more. No additional data were collected on individual physical activity levels as well as on the specific context and environment in which each participating child was growing up. Consequently, only an assumption-based explanation with regard to the known disparities in the (physical) educational system of both countries was provided on why Belgian and Greek preschoolers' motor skill performances differ to some extent. Finally, using the product-oriented BOT-2 SF, no information on children's movement patterns underlying their particular test outcomes could be provided.

Conclusions and Future Prospects

The targeted promotion of motor skill development for health from an early age onwards requires more insight into cross-cultural differences in motor competence levels and profiles both between and within continents across the globe. Due to the current lack of an internationally accepted gold standard, the choice for a particular test battery with its distinct features will determine (to) what (extent) differences between various subsamples are revealed. Using the BOT-2 SF to assess and compare a wide range of both fine and gross motor skill performances in Belgian versus Greek preschool children aged 5 to 6 years, it was demonstrated that the overall level of motor competence was quite similar in both subsamples. When looking at the mean raw performance scores, however, a between-country difference was established for half of the 14 individual test items. Large effect sizes were found for a better knee push-up performance in Belgian participants as well as a higher score for copying a square in Greek participants. Although caution is warranted when applying U.S. reference standards to European samples (Bardid et al., 2016), more children in both subsamples were classified into the average or (well-)above average performance categories than could be expected based on the test battery's manual.

In the context of cross-cultural comparisons per se, normative standards seem to be of little use. When the main objective is to identify general deficits in children's level of motor competence and address them by means of specific skill interventions adapted to local policies and practices, the primary focus will be on differences in raw performance scores, which usually contain and explain more variance. In addition to large representative and matched subsamples, a combined use of product-oriented and process-oriented assessment tools in future cross-cultural studies is recommended to provide a more comprehensive picture of (region- and/or country-based differences in) motor competence profiles. Another potential advancement to the field includes the use of linear mixed models including random parameters, since accounting for statistical dependencies in the data is important and may impact on the results. Finally, the extent to which the cultural, educational and/or parental context affects a child's level of motor competence in relation to the available opportunities for motor skill development should be further explored. Prospective follow-up studies are needed to investigate whether these assumed effects are temporary or long-lasting in nature.

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Table 1. Overview of the BOT-2 SF test items ($n = 14$), per subtest ($n = 8$) and overarching motor construct ($n = 4$).

BOT-2 SF test structure	Raw performance score (range)	Item point score (range)
FINE MANUAL CONTROL		
Fine motor precision		
Drawing lines through paths, crooked^	0 - 21	0 - 7
Folding paper	0 - 12	0 - 7
Fine motor integration		
Copying a square°	0 - 5	0 - 5
Copying a star°	0 - 5	0 - 5
MANUAL COORDINATION		
Manual dexterity		
Transferring pennies	0 - 20	0 - 9
Upper-limb coordination		
Dropping and catching a ball, both hands°	0 - 5	0 - 5
Dribbling a ball, alternating hands	0 - 10	0 - 7
BODY COORDINATION		
Bilateral coordination		
Jumping in place, same sides synchronized	0 - 5	0 - 3
Tapping feet and fingers, same sides synchronized	0 - 10	0 - 4
Balance		
Walking forward on a line	0 - 6	0 - 4
Standing on balance beam, eyes open	0 - 10	0 - 4
STRENGTH and AGILITY		
Running speed and agility		
One-legged stationary hop	0 - 50+	0 - 10
Strength		
Knee push-ups#	0 - 36+	0 - 9
Sit-ups	0 - 36+	0 - 9

^ A lower raw score indicates a higher performance for this particular test item ($n = 1$) since it represents the number of errors.
° The item point scores actually duplicate the raw scores for these particular test items ($n = 3$).
Knee push-ups were preferred to full push-ups taking the participants' age into account.

Table 2. Descriptive statistics (mean ± standard deviation) of anthropometric measures according to country and sex.

	BELGIUM		GREECE	
Anthropometric measure	**Boys (n = 147)**	**Girls (n = 178)**	**Boys (n = 113)**	**Girls (n = 133)**
Height (cm)	119.7 ± 5.2	119.4 ± 5.6	119.5 ± 6.2	119.7 ± 6.3
Weight (kg)	22.9 ± 3.6	22.5 ± 3.8	23.4 ± 4.2	23.6 ± 4.7
BMI (kg/m²)	15.91 ± 1.69	15.71 ± 1.74	16.22 ± 1.86	16.40 ± 2.35
Weight status (n [%])				
Healthy weight	128 (87.1%)	154 (86.5%)	91 (81.3%)	95 (71.4%)
Overweight	15 (10.2%)	21 (11.8%)	17 (15.2%)	23 (17.3%)
Obese	4 (2.7%)	3 (1.7%)	4 (3.5%)	15 (11.3%)

Table 3. Descriptive statistics (mean ± standard deviation) of BOT-2 SF test outcomes according to country and sex.

BOT-2 SF test outcomes	BELGIUM Boys ($n = 147$)	BELGIUM Girls ($n = 178$)	GREECE Boys ($n = 113$)	GREECE Girls ($n = 133$)
Raw performance scores				
Drawing lines^	2.03 ± 2.21	1.58 ± 2.35	2.23 ± 3.11	1.97 ± 3.38
Folding paper	5.97 ± 3.80	7.95 ± 3.41	5.78 ± 3.51	7.08 ± 3.85
Copying a square	2.35 ± 0.83	2.66 ± 0.96	4.70 ± 0.89	4.80 ± 0.71
Copying a star	1.32 ± 1.14	1.61 ± 1.19	2.35 ± 1.98	2.40 ± 1.96
Transferring pennies	9.13 ± 2.00	9.67 ± 2.18	9.04 ± 2.40	9.29 ± 2.30
Dropping and catching ball	3.89 ± 1.59	3.54 ± 1.73	3.73 ± 1.60	3.28 ± 1.64
Dribbling ball	4.24 ± 2.57	3.33 ± 2.12	2.47 ± 2.05	1.78 ± 1.60
Jumping in place	3.98 ± 1.47	4.49 ± 1.18	3.94 ± 1.85	4.13 ± 1.58
Tapping feet and fingers	7.71 ± 3.24	8.73 ± 2.41	9.40 ± 1.93	9.66 ± 1.48
Walking forward on a line	5.75 ± 0.75	5.86 ± 0.48	5.96 ± 0.23	5.89 ± 0.66
Standing on balance beam	6.09 ± 3.37	7.06 ± 3.37	6.20 ± 3.31	6.87 ± 3.44
One-legged stationary hop	39.46 ± 7.09	36.64 ± 7.44	30.19 ± 13.33	32.27 ± 11.18
Knee push-ups	18.93 ± 5.14	16.74 ± 5.91	9.81 ± 6.27	8.34 ± 6.29
Sit-ups	10.96 ± 6.98	12.04 ± 6.94	9.86 ± 6.07	12.40 ± 6.02
Total point score	53.79 ± 7.07	55.35 ± 7.15	51.66 ± 8.92	52.88 ± 8.27
Normative standard score	52.16 ± 6.80	48.38 ± 7.65	53.96 ± 8.77	50.78 ± 8.54

^ A lower raw score indicates a higher performance for this particular test item ($n = 1$) since it represents the number of errors.

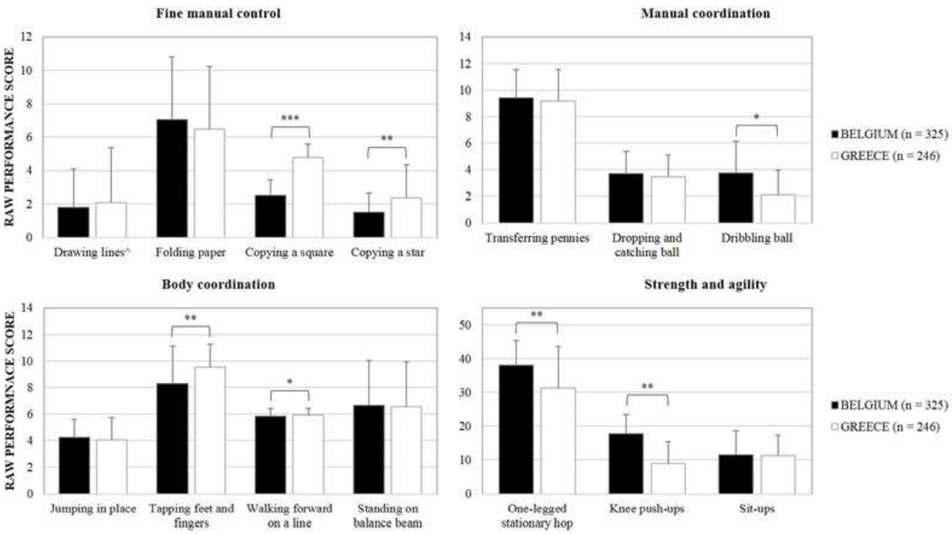

Figure 1. Between-country differences in raw performance scores on the BOT-2 SF test items assessing both fine (i.e, upper panel) and gross motor skills (i.e., lower panel), with an indication of significant findings (i.e., * = *p* < .05; ** = *p* < .01; *** *p* < .001) as well as the single test item with reverse scoring (i.e., ^).

68x38mm (300 x 300 DPI)

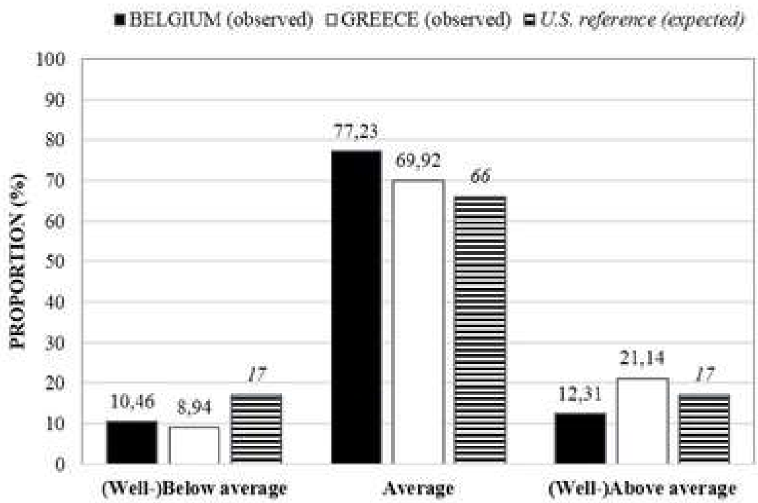

Figure 2. Proportion of children (in %) across the BOT-2 SF descriptive performance categories for both countries with respect to the expected distribution based on the orginal U.S. reference sample.

34x22mm (300 x 300 DPI)