

# A Comparison of the Motor Ability of 8 and 9 Year Old Primary School Children in Hamburg, Melbourne and Cape Town — An Exploratory Study

by Jürgen Kretschmer, University of Hamburg; John Saunders, Australian Catholic University; Liz Bressan, Stellenbosch University; Jan Erhorn, University of Flensburg and Daniel Wirsing, University of Hamburg

## Abstract

An increasing worldwide concern about a decline in the quality of the motor ability of children was the motivation for this exploratory comparative study. It involves a comparison of the motor ability of children aged 8 and 9 years from Hamburg (n=774), Melbourne (n=141) and Cape Town (n=81). Since each of these global cities represents a typically culturally diverse modern center of population, data were also tentatively analyzed according to ethno-cultural background, as a potential contributing variable to better understand the results of studies such as these.

The children's motor abilities were tested by five items from the *Allgemeiner Sportmotorischer Test für Kinder* or AST 6 – 11 (Bös, Opper, Woll, Liebisch, Breithecker, & Kremer, 2001). Results were analyzed in terms of city and sex by means of a two-way Analysis of Variance (ANOVA). A composite motor profile was also constructed using all five items. This was then used in a further comparison of major ethno cultural groups within each of the three cities.

Differences in motor ability were evident between the children of the three cities. The children from Hamburg demonstrated the highest levels of performance overall and those of Melbourne the lowest. Both sex and ethno-cultural background were significant mediating variables in all contexts. Boys scored higher than girls on the AST 6-11 at all locations. For children of a European background in both Hamburg and Melbourne, a higher performance was identified when compared with their same city peers of Asian origins. The best performing cultural group overall were the Black African (Xhosa) children of Cape Town. The limitations of the study were identified and some suggestions for future comparative studies of motor ability were made.

*Keywords:* comparative studies, culture

Concern about the levels of motor ability and motor fitness of children and adolescents is emerging worldwide. However, to date there have been few published reports of this phenomenon from outside the high-income nations of the Organisation of Economic Co-operation and Development (OECD). Rather, studies in the USA (Kuntzleman & Reiff, 1992), Canada (Craig, Beaulieu, & Cameron, 1994) and Australia (Booth, et al., 1997; Tomkinson, 2004) have been among the first to have reported such a decline in motor achievement. In Germany some authors have made similar claims (Bös, 2003). Questions as to what extent this is a worldwide issue and, what may be the main factors related to it, can only be answered by comparative studies. However, comparative studies at the international level investigating both motor ability and

the environmental factors, which relate to it have been limited (Baur, 1993). This is, at least in part, because the administration of comparative studies is complex, difficult, and consequently expensive.

As a starting point for exploring some of the conceptual and methodological issues to be addressed in such studies, this study compared the motor ability of children from three modern world cities on three different continents. It is based on some of the protocols developed for the Hamburg study - *Motorische Leistungsfähigkeit von Grundschulkindern in Hamburg* (MOLE, Kretschmer & Wirsing, 2008), which were then applied to two smaller convenience samples of children from Melbourne in Australia and Cape Town in South Africa. The purpose was to look for similarities and differences in the motor ability of the children who were the participants in these three examples of contemporary city life. At the same time, acknowledging the growing ethnic and cultural diversity of major world cities and accepting this as being a possible source of increasing variance in movement culture within populations, we also sought to explore the potential significance of ethno-cultural group membership upon motor-related activity and performance even within the same geographical regions.

## Research Background and Design

This study investigated the motor ability of selected primary school children from the greater metropolitan areas of Hamburg, Melbourne and Cape Town. The common ground between the three locations is that they are all cities within countries in which a decline in the motor ability of children has been reported (Armstrong, 2009; Bös, 2003; Tomkinson 2004). The three cities are fairly similar in population (from 2 million to 4.16 million), are the second largest cities in their relative countries, important and prospering seaport and commercial centers suggesting their suitability for comparison. Differences in population densities between the three need to be acknowledged as a potentially relevant source of difference, as there are 2,382 people per square kilometer in Hamburg, 1,665 in Cape Town and only 462 in metropolitan Melbourne. This, however, appears to reflect characteristics of city growth in their respective global regions of Europe, Africa and Australia. At the same time, as exemplifying modern international cities, all three boast populations that are characteristically diverse in terms of a variety of socio-cultural variables such as ethnicity and religious orientation. The explanations behind these diversities are varied and reflect the national and regional histories of each city.

For our exploration, the common ground was that in each city clearly identifiable and numerically significant subgroups could be found which preserved a culture that had unique characteristics and differentiated them from others in their shared geographical environment. We, therefore, posed the question as to whether these differentiated experiences might impact on the ways that children

experienced physical activity and hence their motor performance. In the case of Hamburg, 15% of the population were classified as aliens, the largest group of which were of Turkish origin (The Times, 2012). In Melbourne over a third (36%) of the population was born overseas exceeding the national average of 23.1 % (Australian Bureau of Statistics, 2011). Melbourne has the second largest Asian population in Australia, as a result of immigration patterns over recent years. Increasing numbers in recent years have come from India and Sri Lanka but traditionally the intake has been from East and South East Asia. South African census figures (Statistics South Africa, 2012) report its population using the following categories - Black African, Coloured, White, Asian and others. Figures for the 2011 census for Cape Town report the majority as being either Coloured (42%) or Black African (39%). Whites and Asian comprised 16% and 1% respectively (City of Cape Town, 2012). It should be noted however that the Cape Town figures are not reflective of South Africa's national distribution, which reports 79.2% as Black and only 8.9% as Coloured (Statistics South Africa, 2012).

A number of German studies have indicated that the level of motor performance is culturally marked. Stemper, Meier, Bachmann, Diehlmann & Kemper (2006) investigated the motor ability of 3,982 children of grade 2 with 80.1% of German origin and 19.9% comprising migrants of 62 nationalities. A comparison of the means of the motor abilities revealed that children with a migrant background achieved a significantly worse motor performance than their native German classmates ( $p \leq 0.01$ ). The motor ability and the proportion of those with membership of a sports club were significantly higher in the case of the migrant boys (35.1%) than in that of the girls (19.65) with a migrant background (Stemper et al., 2006). Similar findings have been reported by Greier and Riechelmann (2012) for kindergarten children ( $n=1,063$ ) from age 4 to 5, Kretschmer and Wirszing (2008) for primary school children ( $n=2,118$ ) from age 6 to 10 and Bös, et al. (2009). The latter was a nationwide representative study of the motor ability and the physical and sports activities of children and adolescents ( $n=4,529$ ) conducted on behalf of the German Ministry of the Interior. Differences in participation in physical activities were commonly observed in these studies as providing a possible explanatory link for the observed differences in performance. Similar findings linking culture and participation in physical activity have been reported in an Australian context. Booth, et al. (2006) reported that boys (and to some extent girls) from Asian backgrounds and girls from Middle Eastern backgrounds were less active, and that boys from an Asian background were more sedentary than other boys. They also reported that motor proficiency was markedly lower among students from Middle Eastern backgrounds, particularly girls, and that children with Middle Eastern backgrounds were more likely to be in an unhealthy weight range.

Although South Africa presents a different case in terms of migration, it is also a country embracing different ethnic groups where integration has been inhibited over time as an inheritance of apartheid. Today, Whites and Coloureds experience a higher socioeconomic status, a better education and greater facility with English or Afrikaans language. In contrast the majority of the Blacks are on a lower socioeconomic level, less well educated, and speak only one of the African native languages fluently. Physical

activity and motor ability differences, have likewise been reported between these groups. In a study of 10,295 children aged 6-13, Armstrong (2009) reported that while White children spent an average of 130 minutes per week playing sport, Black children spent 29 minutes. White children generally had the highest scores on the tests of physical fitness, with Black children scoring the lowest. The performance of Coloured children tended to fall between that of the other two ethnic groups (Armstrong, 2009). Differences in height and mass were also observed between the different ethnic groups, with the White children being the tallest and heaviest and the Black children the shortest and lightest across both genders (Armstrong, 2009).

For this current exploration of whether such differences would be likely to persevere between children raised in the same or similar cities, each of the samples from each of the cities were classified with regard to their major cultural origins. The criterion used for this classification was the language the children reported speaking at home in their family. Language is the most widely assessed cultural practice associated with ethnic identity (Phinney, 1990, 505) and it has been used successfully in several studies (Greier & Riechelmann, 2012).

The initial study (Kretschmer & Wirszing, 2008) originated in Hamburg before being extended into the South African and Australian contexts. When the authors decided to progress to the present comparative study, it was decided to collect basic anthropometric data (height and weight). These were collected for the Cape Town and Melbourne samples, but were not a part of the original German study and therefore not available for the Hamburg sample.

## Methods

### Participants

A total of 996 students aged 8 and 9 years provided the data for this study. To the 774 eligible students from the Hamburg study were added a total of 141 Melbourne and 81 Cape Town students. Prior to the collection of data, ethical approval for the conduct of the research at each location was obtained in accordance with the procedures of the local university involved. The classification of the sample into ethno-cultural groups in each of the three cities, together with numbers and percentages in each category, is

**Table 1. Classification of Ethno-cultural Groups**

Classification of children		
City	'Dominant' group	'Minority' Group
Hamburg n = 774	German origin (88.6%) M 353: F 333	Near and Middle Eastern origin (11.4%) M 45: F 43
Melbourne n = 141	European origin (predominantly Anglo/Celtic) (83.7%) M 52: F 57	East and S-EastAsian origin (16.3%) M 12: F 10
Cape Town n = 81	White and Coloured origin (56.8%) M 23: F 23	Black African (Xhosa) origin (43.2%) M 20: F 15

summarized in Table 1. It should be noted that the application of the 'language of the home' criterion, placed what in South Africa are considered two distinct racial groups – 'white' and 'coloured' – in the same category. On the basis that the consistent application of the criterion of the study still identified a consistent cultural difference between the two Cape Town groups, this was considered appropriate for an exploratory study of this nature.

### Instruments

The motor abilities of the children were tested by selected items from the *Allgemeiner Sportmotorischer Test für Kinder* (AST 6 – 11) (Bös et al., 2001). The AST 6-11 had been originally developed in 1984 by Bös and Wohlmann and published in 1987. It had good face validity being underpinned by a theoretically appropriate model of motor ability based on measurement of the components of speed, power, cardiovascular endurance, agility, hand-eye and whole body co-ordination. The items were easy to administer and required only simple equipment, an important consideration in international studies of this nature. Inter-rater reliabilities have been reported of between 0.74 – 0.94 for each test item and 0.93 for the entire battery. The following five items have been included (see limitations).

**20 m-run.** The test item *20 meter run* provided a measure of speed. Children had two attempts; the best one was used. Time was recorded to the nearest tenth of a second.

**Target throw.** The test item *target throw* provided a measure of hand-eye co-ordination for accuracy. The children had to throw a tennis ball as close as possible to the center of the target, which was three meters away and consisted of three concentric cardboard discs (10, 30 and 60 cm squares). 0, 1, 2 or 3 points were given. The sum of 10 throws was recorded.

**Ball-legs-wall throw.** The test item *ball-legs-wall throw* checked the co-ordination of the entire body under precision pressure. The child started the exercise by standing with their back at three meters distance from the wall. The ball was then thrown through the legs onto the wall and an attempt made to catch the rebounding ball before it hit the ground after completing half a turn of the body, – all with as little locomotion as possible. Depending on how well the three components (throw – turn around – catch) of the item were performed, 0 – 5 points were given. The sum of 10 attempts was then recorded.

**Medicine ball push.** The test item *medicine ball push* measured the strength and power of the arm and shoulder muscles. A one kilogram medicine ball was pushed with both hands as far as possible from a standing position. The better result out of two trials was recorded to the nearest 10 cm.

**Six-minute run.** The test item *six-minute run* provided a measure of aerobic cardiovascular endurance. The children ran along the side lines of a volleyball court for six minutes. The distance achieved in that time was recorded in meters.

In all settings children were tested in a single session on a whole class basis. Trained student assistants were placed at a single station and the children were rotated between stations at the direction of the senior author. In all cases the six-minute run was administered after completion of the other items. A verified English translation of the original German manual outlining the protocols used in the Hamburg study was used in Cape Town and

Melbourne. Student assistants were all prepared and trained by the lead author before data collection. Training involved the setting up of the test environment, the introduction of the students to the execution of each task and measurement of the test performance.

### Limitations

The sampling procedures used prevent any true generalizability from this study; nonetheless it is believed that the convenience samples from Cape Town and Melbourne were largely characteristic of the children in those cities. Brettschneider and Brandl-Bredenbeck, (1997) observed it is simply impossible to ensure equivalent environmental circumstances when collecting field based data in studies like this, especially when, as in the testing for the Cape Town and Melbourne children, they were collected outdoors. As reported above, efforts were taken to minimize inter-rater variability. However, from the environmental perspective, for the Hamburg sample all tests were administered indoors, whereas those in Cape Town and Melbourne were administered outdoors in their normal physical education environment. While the children of the Hamburg sample predominantly wore sports clothes and shoes, the children in the Melbourne sample completed the test tasks in their school uniforms, and the Xhosa children in their street clothes and sometimes barefoot. With regard to the assessment instruments, despite attempts to standardize equipment used, one item – the *boomerang run* – used to measure agility, had to be excluded from the analysis due to an inability to assemble apparatus in Cape Town and Melbourne comparable to that used in Hamburg.

### Data Analysis

The mean scores for performance on each item for the sample from each city are presented for boys and girls. The effects of city and sex on performance were analyzed by using a two-way analysis of variance (ANOVA) and presented for each item. To examine the relationships between weight, height, BMI, and performance on the individual items (for the Cape Town and Melbourne samples only) the performance results were correlated with the available anthropometric data. Finally composite motor profiles were calculated by summing performance on all five individual items. In order to add items with different metrics all performances were first compared with the standardized sample of Bös et al. (2001) according to age and sex. The raw scores were then converted into individual Z-values based on the Bös et al norms, before being summated for each participant. These composite scores were then reported as group means for city, sex and ethno-cultural group membership.

## Results

### Anthropometric Data

A comparison of the basic anthropometric data (Table 2), which had been recorded for the Australian and South African children only, shows that in Melbourne the boys were taller and heavier than the girls. However in Cape Town, the girls though smaller than those in the Melbourne group were both taller and heavier than their male peers and with a higher BMI. In the case of the boys the differences in height and weight between the Australian and the South African children were highly significant ( $p = .000$ ), for the

girls however it was in height ( $p = .049$ ) only that the Australian students exceeded their South African counterparts.

**Table 2. Basic Anthropometric Data for the Melbourne and Cape Town Samples ( $\bar{X}$ ) ( $\sigma$ ):  $n=213$ )**

Anthropometric Data						
City	Height (cm)		Weight (kg)		BMI	
	female	male	female	male	female	male
Melbourne	132.4 ( $\pm 6.5$ )	137.6 ( $\pm 9.7$ )	30.5 ( $\pm 6.6$ )	32.1 ( $\pm 7.7$ )	17.3 ( $\pm 2.8$ )	17.1 ( $\pm 3.6$ )
Cape Town	130.7 ( $\pm 6.1$ )	128.5 ( $\pm 6.5$ )	28.1 ( $\pm 6.3$ )	26.1 ( $\pm 3.4$ )	16.4 ( $\pm 2.7$ )	15.8 ( $\pm 1.4$ )

**Comparison of Motor Ability**

The analysis revealed a number of differences in the comparative performance of the Hamburg, Melbourne and Cape Town children in all test items. These are reported in terms of the components best represented in each item.

**Speed (20 meter run).** Table 3 shows that the performance of the children from Hamburg ranked slightly higher than that of their peers from Cape Town. The Melbournian children ranked the lowest. An ANOVA showed a highly significant difference between the three samples ( $F_{5/964} = 10.928$ ;  $p = .000$ ). A significant main effect was observed for both city ( $F_{2/967} = 6.736$ ,  $p = .001$ ) and sex ( $F_{1/968} = 24.735$ ,  $p = .000$ ) meaning that the achievement of the children differed significantly between the boys and the girls as well as between the children of Hamburg, Melbourne and Cape Town. There was no significant interaction between city and sex ( $F_{5/967} = .646$ ;  $p = .525$ ). In the case of the Melbourne and Cape Town samples a significant correlation was noted between performance on this test and both the weight ( $r = .225$ ;  $p = .001$ ) and the BMI ( $r = .266$ ;  $p = .000$ ). Namely the bigger heavier children ran slower than their lighter classmates.

**Table 3. Performance on the 20 m Run (Mean Scores in Seconds with Standard Deviations in Parentheses)**

Gender	City		
	Hamburg	Melbourne	Cape Town
Male	4.33 (.25)	4.46 (.41)	4.34 (.41)
Female	4.57 (.39)	4.65 (.39)	4.49 (.41)

**Hand-eye coordination (Target throw).** A highly significant difference between the groups was found on this item ( $F_{2/946} = 19.389$ ;  $p = .000$ ). The performance of the children of Cape Town with a mean score of 14.91 points was significantly better than the performance of the children of Melbourne with a mean score of 11.84 ( $p = .000$ ), closely followed by the children of Hamburg with 11.7 points ( $p = .000$ ). The difference between the performance of the students of Melbourne and Hamburg was not significant. The boys from Cape Town achieved the best result, the girls from

Hamburg the poorest. The results show clear differences both by city ( $F_{2/949} = 21.737$ ;  $p = .000$ ) and sex ( $F_{1/950} = 80.371$ ;  $p = .000$ ) with the greater difference being by sex, with no significant interaction ( $F_{2/949} = .1100$ ,  $p = .333$ ) being observed. No correlation was found between height, weight and BMI measures and the target throw item.

**Table 4. Performance on the Target Throw (Mean Scores in Points with Standard Deviations in Parentheses)**

Gender	City		
	Hamburg	Melbourne	Cape Town
Male	13.42 (4.02)	13.27 (4.49)	17.09 (3.44)
Female	9.84 (4.41)	10.48 (3.68)	12.58 (3.73)

**Whole body co-ordination (Ball-legs-wall throw).** The children of Hamburg reported significantly higher scores than the children of Melbourne and Cape Town ( $F_{2/970} = 30.887$ ,  $p = .000$ ). Once again both city and sex showed a significant main effect ( $F_{2/969} = 35.164$ ,  $p = .000$ ;  $F_{1/970} = 77.186$ ,  $p = .000$ ) with no significant interaction between them ( $F_{2/969} = .519$ ,  $p = .595$ ). The Hamburg girls performed significantly better than the girls from Melbourne ( $p = .000$ ) and Cape Town ( $p = .000$ ). Hamburg's boys also achieved better results than their peers from Melbourne ( $p = .016$ ) and Cape Town ( $p = .001$ ). No significant correlation was observed between performance on this item and the BMI, weight or height measures.

**Table 5. Performance on the Ball-Legs-Wall Throw (Mean Scores in Points with Standard Deviations in Parentheses)**

Gender	City		
	Hamburg	Melbourne	Cape Town
Male	25.24 (9.63)	18.58 (9.29)	21.16 (9.63)
Female	17.93 (8.66)	11.96 (9.53)	12.0 (6.01)

**Power (Medicine ball push).** Once more there was a significant effect for city ( $F_{2/969} = 35.773$ ,  $p = .000$ ) with the children of Hamburg gaining the highest scores compared to the children of Melbourne ( $p = .000$ ) and Cape Town ( $p = .000$ ). The differences between the Melbourne and the Cape Town students, however, were not significant. The German girls actually performed better than the boys of the other two cities on this item and the gap between the girls and the boys in Melbourne and Cape Town was noticeably smaller. Consequently for this test, although sex still provides a significant main effect on performance ( $F_{1/970} = 23.603$ ,  $p = .000$ ); there is a significant interaction between the two ( $F_{2/969} = 5.335$ ,  $p = .005$ ) which means that the nature of the impact of sex differs between the three samples. A significant correlation was found to exist between performance of the medicine ball push and participants' BMI ( $r = .174$ ;  $p = .011$ ), weight ( $r = .413$ ;  $p = .000$ ) and height ( $r = .524$ ;  $p = .000$ ).

**Table 6. Performance on the Medicine Ball Push (Mean Scores in Metres with Standard Deviations in Parentheses)**

Gender	City		
	Hamburg	Melbourne	Cape Town
Male	4.17 (.82)	3.52 (.71)	3.37 (.60)
Female	3.55 (.76)	3.15 (.72)	3.38 (.51)

**Cardiovascular endurance (Six minute run).** The results achieved by the samples differed significantly ( $F_{2/954} = 16.837$ ;  $p = .000$ ). The Cape Town children performed best and they were significantly better than both the Melbourne ( $p = .000$ ) and Hamburg children ( $p = .009$ ). Sex featured as a more highly significant variable in determining performance ( $F_{1/955} = 28.652$ ;  $p = .000$ ) with an interaction between city and sex ( $F_{2/954} = 8.188$ ;  $p = .000$ ). It can be seen that across the three samples the performances of the girls did not differ much. The Melbourne girls ran about 36 meters less than the top performing girls' group from Cape Town which was not significant ( $F_{2/468} = .948$ ;  $p = .388$ ). However this was quite different in the case of the boys. The Melbourne sample only completed a mean distance of about 860 meters in the available time which was about 185 meters less than the distance run by their Cape Town counterparts ( $F_{2/484} = 22.108$ ;  $p = .000$ ).

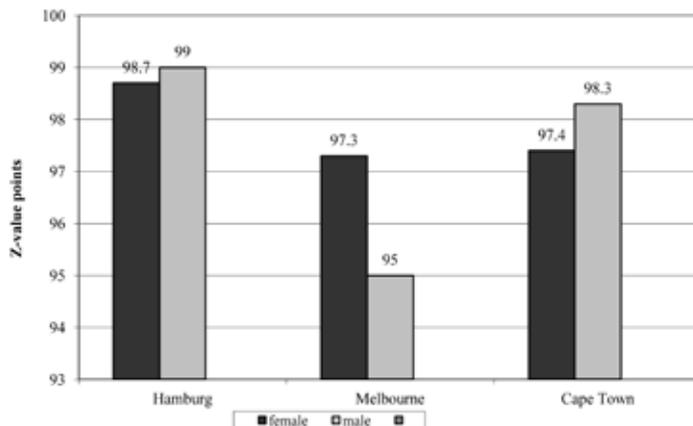
**Table 7. Performance on the 6 minute run (Mean Scores in Metres with Standard Deviations in Parentheses)**

Gender	City		
	Hamburg	Melbourne	Cape Town
Male	968.5 (137.5)	859.5 (157.4)	1044.5 (199.7)
Female	884.7 (118.8)	866.4 (148.3)	902.1 (201.6)

Not unexpectedly for this endurance test, a negative correlation was found in the case of the Melbourne and Cape Town children between performance and both BMI ( $r = -.284$ ;  $p = .000$ ) and weight ( $r = -.272$ ;  $p = .000$ ).

**Composite Motor Profiles**

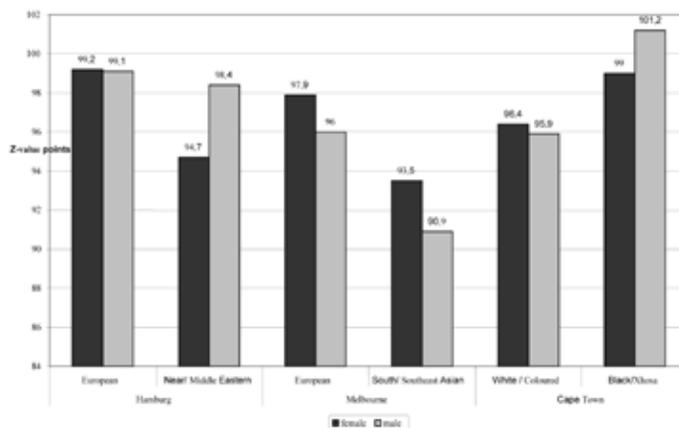
Figure 1 provides a comparison of the overall performances of the children in this study by means of a composite motor ability score, obtained by summing the results for the five individual measures obtained in this study. The results reported here represent a standardized score with 100 points representing the average score recorded by the original German sample of Bös et al. (2001). Scores have been separately standardized according to gender. The scores between the samples in this study differ significantly ( $F_{2/967} = 10.648$ ;  $p = .000$ ). The students from Hamburg performed best overall and they were better than the Cape Town ( $p = .402$ ) and significantly better than the Melbourne students ( $p = .000$ ).



**Figure 1. Comparison of Generalised Motor Ability (Mean Standardized Scores)**

In the case of the boys ( $F_{2/495} = 11.088$ ;  $p = .000$ ), the results of the Melbourne boys were significantly worse than those of the Hamburg ( $p = .000$ ) and the Cape Town boys ( $p = .033$ ). With the girls there was no significant difference ( $F_{2/471} = 3.050$ ;  $p = .130$ ). A negative correlation was found between the overall performance of the Melbourne and Cape Town children of both sexes and their BMI ( $r = -.149$ ;  $p = .030$ ).

The comparison of the general motor ability of the ethno-cultural groups presented in Figure 2, underlines the complexity of the total picture. The differences between the standardized levels of performance of the six ethno-cultural groups are significant ( $F_{5/931} = 11.276$ ;  $p = .000$ ). In terms of ranking, the Xhosa (Black African) children scored the highest closely followed by the German and Near or Middle Eastern children of Hamburg, the European children of Melbourne and, the White and Coloured of Cape Town.



**Figure 2. Comparison of General Motor Ability Scores by Ethno-cultural Groups (Mean Standardized Scores)**

The difference between the groups is significant only in the case of the East and Southeast Asian children of Melbourne ( $p = .000$ ). Sex, naturally, had no significant main effect on performance in this comparison ( $F_{1/968} = .025$ ,  $p = .875$ ) because it had been accounted for in advance by using the Z-value calculation. But there is a significant interaction between ethno-cultural groups and sex ( $F_{5/964} = 2.551$ ,  $p = .026$ ), which means that the impact of sex

differs between the samples. While in Hamburg only the girls with a Near and Middle Eastern background showed poorer relative achievement, in Melbourne it was both the male and female South and East Asian children. In Cape Town, however, not only did the Xhosa boys have a better relative performance than the boys of White/Coloured origins, but they performed the best of all the groups. This was mainly attributable to their above average performance in the target throw and their extraordinarily good performance in the 6-minute run. A breakdown of all the relative group performances for each of the items is shown in Table 8. This provides for an item-by-item comparison by using the standardized scores for each task as a basis to categorise the performance of each group by quintiles. Performance of the group was thus rated on each item as being far below average (0-20 percentile), below average (20-40 percentile), average (40-60) above average (60-80) or far above average (80-100) in comparison with the 2001 German reference group.

The most consistent performance was shown by the German children of Hamburg, who achieved the average four times (20 meter run, target throw, medicine ball push, 6-minute run), and missed it once. The performance in the target throw was average or above for all ethno-cultural groups, which indicates improved levels of hand-eye co-ordination in comparison with the German reference population. However all groups performed below the reference population in the ball-legs-wall task which also reflects co-ordination, but at the level of whole body management. This difference may reflect increased exposure to perceptually dominated tasks perhaps through computer style games but less experience of managing whole body responses in association with such external stimuli. The significance of this difference needs attention in future studies.

between the performances of children growing up in the differing contexts provided by major international cities in the first decade of the twenty-first century. In the three contexts of this study, the Hamburg students achieved the highest level of motor performance, followed closely by the students of Cape Town. The performance of the children of Melbourne was significantly lower ( $F_{2/966} = 10.648$ ;  $P = .000$ ) than that of the children in both the other cities. However there is a degree of complexity within this broad general picture which needs to be further unravelled. For example there were differences with regard to performance on individual test items within the three samples. In three of the five test items (20m run, ball-legs-wall throw, and medicine ball push) the Hamburg children achieved the best results consistent with their overall superior motor ability. However, in two test items (target throw, 6-minute run) the Cape Town children were the best performing. The Melbourne children were poorer throughout, yet scored a little better in the throwing measures – both throwing for accuracy and throwing for power - when compared with the other items. Whether this reflects differences in the general movement culture or the impact of specific curriculum interventions such as the Fundamental Motor Skills program, which is a part of the PE curriculum in Melbourne, would be an interesting line of further enquiry. For example, studies in the neighbouring state of New South Wales reported that proficiency in fundamental movement skills increased markedly between 1997 and 2004 (Booth et al., 2006), possibly in association with their education system initiatives in that area.

The nature of the observed differences in the performance between the sexes confounds the issue even more. This study reveals clearly that sex was a consistent variable in distinguishing differences in performance and far more significant than city of residence alone. The persistent strength of this variable at this age surprised us and it was almost entirely independent of location, with only two test items showing any interaction between city and sex – the 6-minute run and the medicine ball push. The latter was largely because of the poor performance of the boys from Cape Town and Melbourne, who both performed more poorly than the girls of Hamburg in this test of upper body power.

Not unexpectedly a significant correlation was found between the anthropometric data collected for the Cape Town and Melbourne samples and the motor abilities of speed, power and endurance. Their higher BMI, weight and height may contribute to an explanation of the relatively poorer performance of the Melbourne children in the running items - both 20 meter and 6 minutes - and their better performance in the medicine ball push.

The findings of this study also suggest that ethno-cultural group membership does add further complexity to attempts to interpret results such as these. In these findings, the children with a German and European background in Hamburg and Melbourne performed better than their peers with Middle Eastern and East Asian backgrounds. In the case of Cape Town the Black African (Xhosa) children demonstrated a higher level of performance than their White and Coloured peers which is contrary to the findings of Armstrong, (2009) in her South Africa wide study of children from 6-13. Indeed the Xhosa boys were the best performing group in this study and the only one to perform above the reference point set by the 2001 German sample (Bös et al., 2001). This latter point of

**Table 8. Categorisation of individual test items performances against German Reference Group (Bös et al., 2001)**

Test Item	City and Ethno-cultural Groups					
	Hamburg		Melbourne		Cape Town	
	German	Middle Eastern	East European	White and Black	Coloured	African /Xhosa
20 metre run	3	3	2	2	3	2
Target throw	3	3	3	3	4	4
Ball-legs-wall throw	2	2	2	1	2	1
Medicine ball push	3	2	2	1	2	1
6 minute run	3	3	2	2	2	5

1 = far below average (percentile range 0 to 20)  
 2 = below average (percentile range 21 to 40)  
 3 = average (percentile range 41 to 60)  
 4 = above average (percentile range 61 to 80),  
 5 = far above average (percentile range 81 to 100)

**Discussion**

Our findings, using an adaptation of the AST 6-11, offer support for the hypothesis that there are clear differences

course suggests that these data provide, albeit tentative, support for the hypothesis that there is a general decline occurring in children's motor ability within our globalized communities worldwide.

This study is an initial attempt to generate data which are comparable, using standardized tests and measurement protocols as a means to a longer term goal of pursuing well-controlled comparative studies that can both identify and increase understanding of changes in children's motor ability and performance in association with changes in contemporary lifestyle. It comes from a belief that despite all the difficulties involved, it is through comparative studies that we can best improve our knowledge by identifying differences and suggesting some reasons for them. The results of this exploratory study show that we can continue to expect to see some differences in the characteristic motor abilities of children located in different cities around the world. Whether within a globalizing world, we should expect increasing convergence in response to increasingly convergent lifestyles, is not yet clear. Further, the results of this descriptive and exploratory study show that despite recent changes in gender definitions, sex still appears to be an important variable in understanding differences in motor ability, as girls' motor performance remains persistently lower than that of boys. More cautiously our findings also suggest that the influence of family culture will have an impact on motor ability that can match or even exceed that of the larger societal culture. We believe there is a need for more extensive research to deepen our understanding of the range of cultural impacts on motor ability. Increasing amounts of literature have been emerging on the differences in children's movement behavior and experience based on culture and ethnicity. For example de Knop, Theeboom, Wittocka, and de Martelaer (1996) explored the experience of Muslim girls in sport within Western Europe, while Brodersen, Steptoe, Boniface, and Wardle (2006) have charted trends in physical activity and sedentary behaviour amongst Black Asian and White British youth.

Recognizing the extent and nature of differences in children's motor development and abilities and progressing on to provide explanations, can ultimately only come from well controlled and resourced comparative studies conducted over time. Such studies will need to be well resourced in order to address some of the issues recognised in this exploratory study and to generate data that are really comparable. However, we believe that children's motor development must remain a major concern of all communities. The fact that variables of gender, location, and ethno-cultural family background are all associated with some differences in performance measures, adds weight to the need for further systematic enquiry around these variables and whether and how they might have some explanatory significance.

Unravelling more of the complexity of how our dynamic and developing 21st century environment impacts upon children's motor development is necessary if we are to enhance our understanding of children's motor development and the situations in which it might be optimized. This is a worthy goal in light of the potential health and educational advantages that could accrue for those children who learn to move effectively and confidently.

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