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The assessment of motor coordination in children with the Movement ABC test: A comparative study among Japan, USA and Spain

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Abstract

The Movement Assessment Battery for Children (Movement ABC; Henderson and Sudgen, 1992) is one of the most popular instrument in the assessment of children with movement coordination problems. It is generally assumed that the published norms for the test are valid for the use with European children and one of the aims of this study was to compare the results of Miyahara's study with Japanese children (53 boys, 49 girls) and the American standardization (237 boys, 284 girls) with the Spanish sample (202 boys and 183 girls).
The cross-cultural comparisons revealed that there are many differences in performance among children of these samples. These differences were distributed among tasks and countries in the two age bands. Gender differences in all samples shown that girls outperform boys in manual and balance tasks, and boys got better scores in ball skills
This data and its analysis so far suggest different consequences: 1) The question of cultural differences in motor skill learning and performance; 2) The problem of gender differences in motor coordination; 3)The norms of the test. As a final consequence it will be necessary to study this test in a larger and more broadly based sample of Spanish boys and girls for being accepted as a useful test in the assessment of motor coordination in Spain.

Key words: *Movement ABC; Motor Coordination, Assessment, Cross-cultural research.*

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1. Introduction

Throughout the European Union interest in children with coordination disorders is continuously growing. Within the school population, it is estimated that approximately 5% to 8% of the children fail to develop sufficient motor competence to allow normal progress in school in general and particularly in physical education (Betts & Underwood, 1992; Morris & Whiting, 1971; Sudgen & Wright, 1998).

Assessment of this kind of problems has been a challenge during the last decades, and many instruments have been developed (see Burton and Miller, 1998).

During the past three decades many scholars in several nations, including Australia, Canada, Germany, Finland, France, The Netherlands, Sweden, UK, U.S.A., etc., have recognized children with coordination problems and the difficulties of the definition of this condition and its assessment and screening by teachers (Cantel, Smyth y Ahonen, 1994; Causgrive y Watkinson, 1994; Cratty, 1994; Degoute, 1979; Flem Maeland, 1992; Geuze and Börger, 1993; Henderson, Elliman, Knight and Jongmans, 1991; Henderson, Knight, Losse and Jongmans, 1991; Kiphard, 1976; Larkin and Hoare, 1991; Miyahara, 1994; Miyahara and Mobs, 1995; Miyahara et al., 1998; Rosblad and Gard, 1998; Smits-Englesman, Henderson and Michels, 1998; WHO, 1992). In these countries research has been conducted to investigate the cause, the prevalence and the management of motor coordination problems in school settings . In some of these nations, educational placement and remedial procedures have been established to meet the needs of these children (Cratty, 1994; Betts y Underwood, 1992; Morris & Whiting, 1971; Gordon and Mckinlay, 1980; Miyahara, 1996; Whitehall and Underwood, 1991; Cantell, Huovinen, Männistö, Larkin & Kooistra, 2002).

This was not the case in Spain. During many years there were no interest in children's motor coordination problems. The study of Ruiz, Graupera, Gutiérrez, and Mayoral (1997) can be considered one of the first efforts in this direction. Although the Spanish educational instructions emphasizes curricular adaptations to attend to special educational needs, there is a dearth of research and documents in the areas of learning disabilities and motor coordination problems. In attempt to accumulate data in these areas a comprehensive study is planned to investigate the motor coordination problems among Spanish school children.

Our specific aim in this study were twofold. The first objective was to compare the results of the Spanish study with Miyahara´s study and the norms of the ABC from the US standardization. Our second objective was to examine the gender differences between the age-band 2 and 3 (7-8 years; 9-10 years) (Ruiz, Graupera and Miyahara, 2000).

2. Method

2.1. Participants

Three hundred and eighty five children (202 boys and 183 girls) from several urban and rural Spanish primary schools at Madrid and Valencia participated in the Spanish study. Every child in these schools between ages of 7 to 9 took part. This research formed part of a more extensive study about developmental coordination problems and learned helplessness among Spanish school children (Ruiz, Graupera, Gutiérrez and Mayoral, 1997).

Their results were compared with to the one hundred and two Japanese children (53 boys, 49 girls) and five hundred and twenty one American children (237 boys, 284 girls) with respect to 8 subtests of the Movement ABC. The number and gender of Spanish children in each age group are displayed in table 1, together with the comparable information from the Japanese study and American standardization.

INSERT TABLE 1 HERE

All children of the Spanish sample followed the National Curriculum prescribed by the Spanish Educational Reform by the Ministry of Education, Culture and Sports, including the physical education curriculum that maintains the general objectives in each course but permits a free application between schools.

2.2. The Movement ABC test

The Movement ABC test is designed for use with children aged 4-12+ years. A total of 32 items are divided into four sets of eight, each intended for use with children of specific ages. The first set of items, labeled Age Band 1 is designed for use with 4-6 year old children, the second set, Age Band 2 for 7 and 8 years old children, the third for 9 to 10 years old and the fourth for children 11 years old and older. The test is identical in its structure in each age band. Three items involve the use of the hands, two items require the children to catch or throw a bean bag or small ball and three items assess static and dynamic balance. In Table 2 we present the characteristics of test items from age band 2 and age band 3, these age bands are the object of this article.

INSERT TABLE 2 HERE

2.3. Procedures

For each child of the Spanish sample, every task of each age band were administered and scored by a group of 10 physical education students in their last year of career, using the criteria described in the Movement ABC Manual. All the participating testers previously had received training by LMR and JLG in the use of the test in a seminar about motor coordination problems.

3. Results

3.1. Qualitative observations

The children of the Spanish sample responded very positively to the different tasks contained in the test. There were no problems in the administration of the test.

A child's performance on the test can be scored in several ways. Raw scores, such as the number of seconds taken to complete a task, the number of catches made, etc (see table 2). All testing took place in the gymnasium or psychomotor education room of the children's school. For the present study our primary interest was to compare the results of the Spanish children (age band 2 and 3) with the results of Miyahara's study and the American standardization.

3.2. Comparisons among the three countries

The means and standard deviations of the raw scores were calculated for the Spanish sample and compared with those of the Japanese study and American standardization, task by task, for each age and gender group in age band 2 and 3 (these analysis were made separately because each tasks are different in each age band). This data are displayed in Tables 3-4.

INSERT TABLES 3 - 4 HERE

The performance of Japanese, American and Spanish children on each task were analyzed using the multivariate analysis of variance (MANOVA). The eight tasks were considered as dependent variables and age, gender and country as a factors. Multivariate tests of significance were used to test the effects of each factor and all possible interactions with MABC items in conjunction. These effects were evaluated through univariate F-tests of significance on each dependent variable. Post-hoc multiple comparisons tests (Bonferroni criteria) analysis were employed as appropriate trying to establish the differences among countries (three groups). The fiduciary limit of $p < .05$ was set for results to be regarded as significant.

3.2.1. Age Band 2 (7-8 years)

MANOVA analysis and multivariate tests of significance (Wilks lambda and approx. F) sums up the results in this age band. Table 5 shows four significant differences ($p<.001$) of the three factors and an interaction between age and country. No other significant differences were obtained. Differences between samples for each dependent variable are presented below.

INSERT TABLE 5 HERE

Manual dexterity

On the three manual dexterity items there were significant differences. The Japanese sample got better scores in relation to the American and Spanish on the first task (MABC1: Placing pegs). American and Japanese children were quicker than the Spanish performing the second task (MABC2: Threading lace) and the Spanish and the American performed with less error when they made the third task (MABC3: Flower trail) (Table 8). There were no differences in terms of gender in these three tasks (Table 6).

When age is considered, children between 7 and 8 years old (see Table 6) improved their performance in MABC1 and MABC 3. No differences were obtained in MABC2.

It is interesting to talk about the interactions got between age and country. As table 7 shows there are a significant effect in these three tasks . MABC1 shows a general tendency to improve between 7 and 8 years; this improvement is more clear in the Spanish sample, moderate in the American sample and minimal in the Japanese children. MABC2 task manifest a cross effect because performance is very similar in American children, better in Japanese at eight years of age and better in the Spanish children at seven years.

INSERT TABLE 6-7-8 HERE

Ball skills

On the two ball skill items, there were no differences among countries. If we consider the gender, in this case we found differences, boys got better scores than girls in this two tasks. In we consider the age of children we found a significant improvement in the two tasks (MABC4: One-hand bounce and catch and MABC5: Throw bean bag in box) at seven and eight years (Table 6). There is a significant interaction between country and age in task MABC4. From seven to eight years there is an improvement in the Japanese and American children but no in the Spanish (Table 7).

Static and dynamic balance

On the three items measuring static balance (Stork balance) and dynamic balance (jump into squares and heel-toe walking), there were three comparisons that reached significant differences among Japanese and Spanish children, and among American and Spanish in task six. American and Japanese sample got better scores that the Spanish.

In relation to gender, only one measure reached significant difference. Girls outperform boys in this task (MABC8: Heel-to-to walking). One tasks, MABC6 (Stork balance) reached significant differences in relation to age, and children at eight got better scores.

When we consider the interaction of age and country we see that there is only one significant difference in MABC8 (Heel-to-toe walking). If American children performed better than the other groups at 8 years and the Spanish manifested a similar tendency, Japanese got their better scores at 7 years of age.

3.2.1. Age Band 3(9-10 years)

MANOVA analysis and multivariate tests of significance (Wilks lambda and approx. F) sums up the results in this age band. Table 9 shows significant differences ($p<.01$) of the three factors and two interaction between age and country, and gender and country. No other significant differences were obtained. Differences between samples for each dependent variable (MABC items) are presented below.

INSERT TABLE 9 HERE

Manual dexterity

On the three manual dexterity items there were significant differences among the three samples (Table 10). Japanese and American children reached significant differences (better scores) performing MABC1 (shifting pegs in rows) task than Spanish children. MABC2 (threading nuts on bolt) differentiate among groups, American were better than Japanese and Spanish, and Japanese better than the Spanish.

Differences between American and Spanish children on task MABC3 (Flower trial) were minimal although significant, and they performed better than Japanese children (Table 12). Gender differences were significant when we compare data on task MABC3 (Flower trail) and in general girls outperform boys (Table 10).

Multivariate analysis found significant interactions in terms of age and country (Table 11). MABC1 showed a tendency to improve between 9 and 10 years, this difference was more clear in the Spanish sample than in the other two groups of children. MABC2 showed a cross effect because performance threading nuts in bolt were better in the American and Spanish

children at 10 years, but this betterment were in the Japanese sample at 9 years old.
If we consider the interaction between gender and country, two comparisons reached statistical significance: MABC1 and MABC2 . There are no differences between boys and girls in the American sample, but Spanish girls are better than boys, and Japanese boys are better than girls shifting pegs into rows. Doing the flower trail American and Spanish got similar results but Japanese girls outperform boys (Table 11).

INSERT TABLES 10-11-12 HERE

Ball skills

On task MABC4 (two-hand catching) significant differences were between the Japanese sample and the American, and between the American sample an the Spanish. American children performed better that the Japanese, and the Spanish better than the American (Table 12). No significant differences were found among countries.
In terms of gender, boys outperform girls doing MABC4 (two-hand catch) and MABC5 (throw bean bag in box) (Table 10). No significant differences were found between the two ages.
There were significant interaction between age and country in the two tasks and a cross effect on MABC4 task. Japanese and Americans reached better scores at 10 years but the Spanish children got them at 9 years of age. Japanese and Spanish were better at 9 years on MABC4 task and the American were better at 10 years.
Another significant interaction were the relationship between gender and country. Japanese and American boys outperform girls catching balls (MABC4), this differences are minimal in the Spanish sample. Something similar occurs throwing a bean bag to a box (MABC5).

Static and dynamic balance

On these three tasks there were significant differences in terms of country (Table 10). Japanese and American children got better scores in task MABC6 (one-board balance) and MABC7 (Hopping in squares) than the Spanish children, but in task 8 (ball balance) the significant differences were in favor of the Spanish sample, that got better results than the Japanese and American samples (Table 12).
Only gender by country interaction reached statistical significance in task MABC6 (one-board balance). Girls performed better that boys among Japanese and American children but worst in the Spanish sample.

4. Discussion

In this paper, we have presented data on how seven to ten years-old Spanish children perform on the Movement ABC test when compared to the Japanese and the American children. Different European studies have suggested that MABC norms are satisfactory (Smits-Engelsman et al., 1998; Rösblad and Grad, 1998) but one of the practical usefulness of this study is that it suggests the norms provided in the manual are not valid for Spanish children, and it is necessary to develop new norms in this country.

As in Miyahara's study the ethnic homogeneity of the Spanish sample it was not a major issue, as the educational experience. In Spain every child practice no less than two hours of regular physical education in a coeducational setting. Out of many comparisons made among Japanese, American and Spanish children, country, gender and age differences reached significance.

When we examined this differences and its characteristics item by item different patterns emerged. When Japanese, American and Spanish children are compared in manual dexterity tasks emerged a interesting cultural and children's understanding difference. If we analyzed this data, American and Spanish children reached better scores in the Flower trail task than the Japanese, and the Spanish sample got worst results on task MABC1 and MABC2. This situation make us think about how children in different countries and cultures understand the objective of these tasks. All of these dexterity task demands a compromise between speed and accuracy. Success performing MABC1 and MABC2 demands speed, MABC3 demands accuracy. Cause Japanese and American are systematically better in speed tasks and Spanish children in the accuracy task, make us think about the different understanding that children manifest when they have to do these tasks. Miyahara et al (1998) explained differences in terms of a systematic biases of testers or in terms of the nature of writing systems in the two cultures when they observed the differences between the Japanese and the American children in his study.

We think that probably is a problem of speed versus accuracy, and it seems as if Japanese and American understand that doing quickly is better and get better results performing MABC1 and MABC2. Spanish children understand that doing well and with less errors it is better, and this produces longer times shifting pegs in a row and threading nuts on a bolt but they manifest more precision doing the flower trail. Here we found a problem of culture when we try to adopt tests developing in other cultural contexts.

Different studies made since 1930 to 1980, found many gender differences in primary school children. Girls outperformed boys in agility, static and dynamic balance, manual dexterity and hoping. Boys reached better scores in ball skills, vertical and horizontal jumps and speed in running (see Zaichkowsky, Zaichkowsky y Martinek, 1980; Ruiz, 1987). This test explore some of these abilities and skills, and these data in our three samples shows a different pattern of change. In our analysis we found that balance differences have changed because we found that the American and Japanese children got better results doing the static balance item, while Spanish children were better doing the dynamic balance item of the test.

Cultural influences in motor performance is clear when we consider the interaction gender by country on static balance (MABC6 task – age - band 3). It is necessary to remember that girls outperform boys in the Japanese and American sample, but between Spanish children boys got better results than girls.

Catching and throwing balls performance are different between boys and girls, but it is interesting to note that gender differences in the two age bands are clear between American and Japanese, but if we consider Spanish data, this differences only emerge in age band 3, and specifically on MABC4 and MABC5 . *Is it possible to talk about the influence of coeducation in the Spanish school system?*. During the last twenty physical educators in Spain had made an strong effort in developing equal opportunities for boys and girls in primary physical education classes., but social influences produces that boys and girls do different activities outside school as they get older. We can speculate that the kind of games that girls play in Spain can be the cause of this data. It is very common that girls play games of skipping and jumping skills more than boys, they prefer games of catching and throwing skills. It is difficult to explain these differences but the ecological niche is more important than we can think, in Spain is very usual to see girls hoping and skipping a great variety of games, and boys playing soccer or basketball. These different activities form the background of experiences that govern the direction of motor development and made very difficult establish the real differences in motor performance, probably it would be better to talk about similarities between boys and girls in motor coordination (Thomas and French, 1985). The present study indicates that the cultural differences affect motor performance.

We can conclude that this study permits to see the differences among three countries and three cultures and three continents. These differences are difficult of explaining with this test, and if we apply the test norms, probably the percentage of Spanish children failing in the 15% were enormous .

The Movement ABC is a test that has some problems in its psychometric properties. Burton and Miller (1998) consider that this test suffers *"the weaknesses inherent in motor ability tests as well as from insufficient evidence of reliability and validity"* (pp.177). This is a problem when we try to compare different studies made in different contexts with different ways of life and understanding of how to do motor tasks. Tan, Parker and Larkin (2001) comparing the MABC test with the McCarron Assessment of Neuromuscular Development (MAND) found that the last one were the more accurate discriminator of motor impairment.

In sum, it will be necessary to study this test in a larger and more broadly based sample of Spanish boys and girls for being accepted as a useful test in the assessment of motor coordination in Spain. It seems necessary to develop new investigations and to establish new norms for Spanish children.

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Table 1: Number of children per age for the Japanese, American and Spanish samples (age band 2 and age band 3)

	Male				Female				Total
Age	Japan	USA	Spain	Total	Japan	USA	Spain	Total	
7	12	64	43	119	13	60	39	112	231
8	16	62	51	129	12	78	44	134	263
Total age band 2	28	126	94	248	25	138	83	246	494
9	7	49	39	95	10	81	43	134	229
10	18	62	69	149	14	65	57	136	285
Total age band 3	25	111	108	244	24	146	100	270	514
Total	53	237	202	492	49	284	183	516	1008

Table 2
Test items from age band 2 and age band 3of the Movement ABC

DOMAIN	ITEM	DESCRIPTION	MEASURES
Age Band 2 (7-8 years)			
Manual dexterity	**MABC1**. Placing pegs	Place 12 pegs in holes of board (preferred and non preferred hand)	Time (seconds)
	MABC2 . Threading lace	Thread lace through holes in board	Time (seconds)
	MABC3. Flower trail	Trace with a pen 2 curved lines without crossing the lines	Number of errors
Ball skills	**MABC4**. One-catch bounce and catch	Bounce a tennis ball on the floor and catch it with the same hand (preferred and non preferred hand)	Number of catches
	MABC5. Throw bean bag in box	Throw bean bag into box with one hand from 2 m	Number of hits
Static/dynamic balance	**MABC6**. Stork Balance	Stand on one foot with sole of other foot against side supporting knee for as long as possible ((preferred and non preferred leg)	Time (seconds)
	MABC7. Jump into squares	Make 5 continuous jumps (feet together) from square to square	Number of jumps
	MABC8. Heel-to-toe walking	Walk along 4,5 m line, placing heel of one foot against toe of other	Number of steps
Age Band 3 (9 –10 years)			
Manual dexterity	**MABC1**. Shifting pegs into rows	Move each of 3 rows of pegs up one row	Time (seconds)
	MABC2. Threading nuts on bolt	Screw 3 nuts down a bolt	Time (seconds)
	MABC3. Flower trail	Trace with a pen between 2 curved lines without crossing the lines	Number of errors
Ball skills	**MABC4.** Two-hand catch	Throw a ball at wall from 2 m and catch with both hands	Number of catches
	MABC5. Throw bean bag in box	Throw bean bag into box with one hand from 2,5 m	Number of hits
Static/dynamic balance	**MABC6.** One-board balance	Balance on one foot on a balance board	Time (seconds)
	MABC7. Hopping in squares	Make 5 continuous jumps on one foot from square to square	Number of jumps
	MABC8. Ball balance	Walk around stands (2,7 m apart) balancing ball on a board	Number of steps

Table 3: Mean scores and standard deviation (*italics*) (age band 2) of the Japanese, American and Spanish samples.

		Male				Female			
Age	Item	Japan	USA	Spain	Total	Japan	USA	Spain	Total
7	**MABC 1**	20.19	25.16	31.04	26.78	21.14	23.52	33.30	26.65
		5.17	*5.56*	*7.37*	*6.17*	*5.04*	*4.20*	*8.86*	*5.92*
	MABC 2	20.19	19.30	22.27	20.46	21.83	16.92	21.89	19.22
		5.17	*7.02*	*6.27*	*6.56*	*5.69*	*4.32*	*8.63*	*5.98*
	MABC 3	4.92	1.84	.62	1.71	5.08	1.44	.33	1.48
		6.36	*2.15*	*1.11*	*2.20*	*4.57*	*1.53*	*.66*	*1.58*
	MABC 4	8.96	8.66	9.04	8.83	8.38	8.09	8.26	8.18
		.75	*1.46*	*1.45*	*1.38*	*1.54*	*1.59*	*1.89*	*1.69*
	MABC 5	5.17	6.36	6.32	6.23	4.92	5.72	4.76	5.29
		1.95	*1.91*	*2.23*	*2.03*	*2.47*	*2.02*	*2.18*	*2.13*
	MABC 6	17.63	14.85	17.50	16.09	18.19	16.60	16.55	16.77
		2.95	*5.47*	*4.27*	*4.78*	*2.50*	*4.91*	*5.06*	*4.68*
	MABC 7	4.83	4.81	5.20	4.95	5.00	4.92	4.76	4.87
		.53	*.71*	*.83*	*.74*	*.00*	*.65*	*2.18*	*1.11*
	MABC 8	14.75	12.25	13.35	12.90	15.00	13.38	14.51	13.96
		.87	*4.23*	*3.14*	*3.50*	*.00*	*2.90*	*2.16*	*2.31*
8	**MABC 1**	20.21	22.19	26.34	23.59	19.21	21.42	25.52	22.57
		2.63	*3.72*	*6.69*	*4.76*	*2.34*	*4.24*	*6.59*	*4.84*
	MABC 2	18.61	17.85	24.69	20.65	18.26	16.62	25.46	19.67
		4.62	*5.55*	*8.44*	*6.58*	*3.27*	*6.03*	*16.00*	*9.06*
	MABC 3	1.94	.62	.74	.83	1.00	.07	.48	.28
		2.43	*1.13*	*1.23*	*1.33*	*1.13*	*1.34*	*.94*	*1.19*
	MABC 4	9.31	9.29	8.71	9.06	9.46	8.79	8.38	8.72
		.85	*1.10*	*1.97*	*1.41*	*.45*	*1.33*	*1.77*	*1.40*
	MABC 5	7.38	7.27	6.60	7.02	5.67	5.78	5.60	5.71
		1.63	*2.03*	*2.27*	*2.08*	*1.78*	*2.05*	*2.41*	*2.14*
	MABC 6	17.72	17.85	17.82	17.82	18.71	17.36	18.13	17.73
		4.04	*4.31*	*7.69*	*5.61*	*2.62*	*4.36*	*3.67*	*3.98*
	MABC 7	4.94	4.71	4.92	4.82	5.00	4.91	5.60	5.14
		.25	*.93*	*1.21*	*.96*	*.00*	*.59*	*2.41*	*1.13*
	MABC 8	13.65	14.24	13.55	13.89	15.00	14.40	14.77	14.58
		3.37	*2.15*	*2.69*	*2.51*	*.00*	*1.72*	*2.96*	*1.97*

Table 4: Mean scores and standard deviation (*italics*) (age band 3) of the Japanese, American and Spanish samples.

		Male				Female			
Age	Item	Japan	USA	Spain	Total	Japan	USA	Spain	Total
9	**MABC 1**	11.30	13.34	19.93	15.90	14.70	13.29	18.50	15.07
		5.61	*2.22*	*4.41*	*3.37*	*3.58*	*1.60*	*4.32*	*2.62*
	MABC 2	20.55	15.19	19.25	17.25	16.27	17.42	21.71	18.71
		10.10	*6.46*	*11.22*	*8.68*	*7.56*	*5.99*	*11.93*	*8.01*
	MABC 3	2.88	.49	.61	.72	1.90	.64	.59	.72
		2.10	*1.02*	*.96*	*1.07*	*1.73*	*.91*	*1.12*	*1.04*
	MABC 4	6.43	8.90	8.00	8.35	5.40	6.28	9.30	7.18
		3.55	*1.61*	*3.32*	*2.45*	*2.91*	*2.38*	*.44*	*1.80*
	MABC 5	6.43	6.76	6.81	6.76	6.30	4.95	6.09	5.42
		2.82	*1.09*	*2.38*	*1.75*	*1.42*	*2.09*	*2.28*	*2.10*
	MABC 6	11.40	10.40	9.03	9.91	13.93	12.90	7.10	11.12
		4.03	*5.66*	*6.29*	*5.80*	*6.23*	*5.65*	*6.13*	*5.85*
	MABC 7	5.00	4.68	4.12	4.47	5.00	4.69	4.65	4.70
		.00	*.97*	*1.52*	*1.12*	*.00*	*1.02*	*1.12*	*.98*
	MABC 8	.00	.35	2.94	1.39	.10	.22	2.02	.79
		.00	*1.25*	*5.79*	*3.02*	*.32*	*.76*	*4.93*	*2.07*
10	**MABC 1**	13.02	12.64	17.28	14.83	12.93	12.61	16.87	14.43
		2.38	*1.57*	*3.97*	*2.78*	*2.24*	*1.33*	*5.01*	*2.97*
	MABC 2	21.44	12.98	15.11	14.99	19.95	15.28	14.08	15.26
		4.52	*5.00*	*7.54*	*6.12*	*5.96*	*4.88*	*7.51*	*6.09*
	MABC 3	2.88	.56	1.25	1.16	1.21	.52	1.33	.93
		2.10	*.97*	*2.06*	*1.61*	*1.53*	*.90*	*2.48*	*1.63*
	MABC 4	7.79	8.61	5.85	7.23	6.43	7.63	6.06	6.85
		2.23	*2.42*	*3.05*	*2.69*	*2.82*	*2.20*	*3.01*	*2.60*
	MABC 5	6.58	6.66	5.41	6.07	5.07	6.00	5.52	5.70
		1.64	*1.82*	*1.93*	*1.85*	*1.49*	*1.93*	*1.88*	*1.86*
	MABC 6	12.05	12.46	7.32	10.03	13.85	14.38	7.19	11.31
		6.66	*5.68*	*4.82*	*5.40*	*6.80*	*5.41*	*4.91*	*5.34*
	MABC 7	4.97	4.67	4.78	4.76	4.96	4.88	4.80	4.85
		.11	*.94*	*1.15*	*.94*	*.13*	*.58*	*1.03*	*.72*
	MABC 8	.00	.16	1.63	.82	.00	.03	1.47	.63
		.00	*.79*	*3.99*	*2.18*	*.00*	*.17*	*3.84*	*1.69*

Table 5. Multivariate Analysis of Variance. Multivariate tests of significance MABC-Age band 2..

Effect	Wilks lambda	Approx. F	Hypoth. DF	Error DF	Sig. of F
Age	.87	9.22	8	475	.000
Gender	.90	6.51	8	475	.000
Country	.49	25.07	16	950	.000
Age by Gender	.97	1.56	8	475	.135
Age by Country	.81	6.48	16	950	.000
Gender by Country	.98	.71	16	950	.786

Table 6 : Multivariate Analysis of Variance. Univariate F-tests of significance. MABC-Age band 2.

	Factor effect					
	Country		Gender		Age	
Item	$F_{(2, 482)}$	Sig of F	$F_{(1, 502)}$	Sig of F	$F_{(1, 502)}$	Sig of F
MABC 1	93.45	.000	.08	.772	30.54	.000
MABC 2	40.21	.000	.18	.673	.04	.842
MABC 3	35.14	.000	2.70	.101	45.66	.000
MABC 4	2.05	.130	8.15	.004	7.78	.005
MABC 5	3.12	.045	22.29	.000	12.85	.000
MABC 6	3.37	.035	.55	.459	4.59	.033
MABC 7	4.32	.014	1.37	.243	.70	.402
MABC 8	5.99	.003	12.74	.000	2.58	.109

Table 7 : Multivariate Analysis of Variance. Interaction effects, univariate F-tests of significance. MABC-Age band 2.

	Age by Gender		Age by Country		Gender by Country	
Item	$F_{(1, 482)}$	Sig of F	$F_{(2, 482)}$	Sig of F	$F_{(2, 482)}$	Sig of F
MABC 1	1.40	.238	8.69	.000	1.83	.161
MABC 2	.00	.946	5.66	.004	1.50	.224
MABC 3	.77	.380	17.34	.000	.12	.883
MABC 4	1.87	.172	4.68	.010	.35	.707
MABC 5	1.54	.215	1.27	.281	.18	.836
MABC 6	.03	.851	1.06	.348	.72	.487
MABC 7	2.71	.100	1.52	.220	.02	.980
MABC 8	.02	.898	7.41	.001	.82	.439

Table 8 : Multiple comparisons by country (Bonferroni, * Significance level .050). MABC-Age band 2.

Item	Country - Country		Mean differences		Std Error	Sig.
MABC 1	Japan	USA	-2.770	*	.840	.003
		Spain	-8.600	*	.874	.000
	Spain	USA	5.830	*	.542	.000
MABC 2	Japan	USA	2.050		1.114	.199
		Spain	-4.000	*	1.159	.002
	Spain	USA	6.050	*	.719	.000
MABC 3	Japan	USA	2.230	*	.258	.000
		Spain	2.610	*	.269	.000
	Spain	USA	-.380		.167	.069
MABC 4	Japan	USA	.320		.225	.465
		Spain	.430		.234	.199
	Spain	USA	-.110		.145	1.000
MABC 5	Japan	USA	-.370		.316	.726
		Spain	.010		.329	1.000
	Spain	USA	-.380		.204	.189
MABC 6	Japan	USA	1.350		.722	.187
		Spain	2.500	*	.752	.003
	Spain	USA	-1.150	*	.466	.042
MABC 7	Japan	USA	.100		.170	1.000
		Spain	-.105		.177	1.000
	Spain	USA	.205		.110	.186
MABC 8	Japan	USA	.930		.392	.054
		Spain	.520		.407	.607
	Spain	USA	.410		.253	.316

Table 9 : Multivariate Analysis of Variance. Multivariate tests of significance MABC-Age band 3..

Effect	Wilks lambda	Approx. F	Hypoth. DF	Error DF	Sig. of F
Age	.96	2.58	8	495	.009
Gender	.95	3.44	8	495	.001
Country	.405	35.73	16	990	.000
Age by Gender	.995	.43	8	495	.900
Age by Country	.77	8.74	16	990	.000
Gender by Country	.87	4.60	16	990	.000

Table 10 :. Multivariate Analysis of Variance. Interaction effects, univariate F-tests of significance. MABC-Age band 3

	Factor effect					
	Country		Gender		Age	
Item	$F_{(2, 502)}$	Sig of F	$F_{(1, 502)}$	Sig of F	$F_{(1, 502)}$	Sig of F
MABC 1	187.56	.000	.45	.505	7.53	.006
MABC 2	10.22	.000	.00	.970	5.17	.023
MABC 3	27.89	.000	6.36	.012	.42	.515
MABC 4	7.11	.001	6.82	.009	1.28	.259
MABC 5	.30	.741	11.98	.001	2.37	.124
MABC 6	45.79	.000	2.79	.095	.39	.534
MABC 7	3.64	.027	1.32	.250	1.94	.164
MABC 8	42.54	.000	.63	.428	2.24	.135

Table 11 : Multivariate Analysis of Variance. Univariate F-tests of significance. MABC-Age band 3.

	Age by Gender		Age by Country		Gender by Country	
Item	$F_{(1, 502)}$	Sig. of F	$F_{(2, 502)}$	Sig. of F	$F_{(2, 502)}$	Sig. of F
MABC 1	1.39	.240	4.44	.012	3.82	.023
MABC 2	.015	.901	7.44	.001	2.62	.074
MABC 3	.63	.428	4.82	.008	4.93	.008
MABC 4	.02	.898	28.86	.000	15.98	.000
MABC 5	.19	.660	8.32	.000	3.30	.038
MABC 6	.01	.903	2.96	.053	4.95	.007
MABC 7	.23	.628	2.02	.133	.65	.523
MABC 8	.18	.673	1.81	.164	.62	.537

Table 12 : Multiple comparisons by country (Bonferroni, * Significance level .050). MABC-Age band 3.

Item	Country - Country		Mean differences		Std Error	Sig.
MABC 1	Japan	USA	.12		.338	1.000
		Spain	-4.83	*	.347	.000
	Spain	USA	4.95	*	.209	.000
MABC 2	Japan	USA	4.45	*	.780	.000
		Spain	2.86	*	.802	.001
	Spain	USA	1.59	*	.484	.003
MABC 3	Japan	USA	1.64	*	.153	.000
		Spain	1.18	*	.157	.000
	Spain	USA	.46	*	.095	.000
MABC 4	Japan	USA	-.96	*	.259	.001
		Spain	-.30		.267	.783
	Spain	USA	-.66	*	.161	.000
MABC 5	Japan	USA	.10		.205	1.000
		Spain	.23		.211	.828
	Spain	USA	-.13		.127	.923
MABC 6	Japan	USA	.17		.605	1.000
		Spain	5.30	*	.622	.000
	Spain	USA	-5.13	*	.376	.000
MABC 7	Japan	USA	.25		.105	.051
		Spain	.35	*	.108	.004
	Spain	USA	-.10		.065	.372
MABC 8	Japan	USA	-.16		.305	1.000
		Spain	-1.89	*	.313	.000
	Spain	USA	1.73	*	.189	.000