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RELATIONSHIPS AMONG MULTIPLE INTELLIGENCES, MOTOR PERFORMANCE AND ACADEMIC ACHIEVEMENT IN SECONDARY SCHOOL CHILDREN

Luis Miguel Ruiz Pérez[1], Miriam Palomo Nieto[2], Irene Ramón Otero[1], Aixa Ruiz Amengual[3], José Antonio Navia Manzano[4]

[1]Technical University of Madrid (SPAIN), [2]Palacky University of Olomouc (CHEZK REPUBLIC), [3]Pinosierrra International School of Madrid (SPAIN), [4]Pontifical University of Salamanca (SPAIN)

E-mails: luismiguel.ruiz@upm.es; miriam.palomo.nieto@gmail.com; irene.ramon.otero@gmail.con; aixaruizamengual@gmail.com;janavia@upsa.es

Corresponding author: luismiguel.ruiz@upm.es

ABSTRACT

This study examines the relationships between multiple intelligences, academic achievement and motor performance in a group of secondary school children. Four hundred and eighty schoolchildren participated in this study (171 female and 309 male) with an average age of 13.33 years (SD: 1.41). The Revised self-efficacy Inventory for Multiple Intelligences (IAIM-R) and the motor test Sportcomp were applied, and the average results of the academic year they had made were obtained. The analysis of the results showed how female scored significantly higher on the Linguistic, Spatial and Interpersonal intelligences, and older pupils scored significantly higher on the linguistic and naturalistic intelligences. It was the logical-mathematical intelligence which showed significant relationships with academic performance and it was the intelligence that better predicted this achievement. It was the bodily-kinesthetic intelligence that was significantly related to motor competence and the best intelligence that predicted its achievement. Finally, indicate that schoolchildren with better scores in the motor test were those who scored higher in both academic achievement and all the multiple intelligences, with the exception of musical intelligence.

Key Words: Intelligence self-perception, Motor competence, Secondary school,

1. INTRODUCTION

Different authors have highlighted that to get on with competence, an intelligence adapted to the contexts where they should act, was needed (Drasgow, 2003; Furnham, 2005; Gardner, 1983, 1993, 1999; Goleman, 1996 & 2006; Sternberg, Forsyte, Hedlund, Horvath, Wagner, Williams, Snook & Grigorenko, 2000; Terenzini, 1993), suggesting the possibility of the existence of intelligences adapted to specific contexts (Castejón, Gilar & Pérez, 2008). So, in the past decades a set of different intelligences have been proposed: Creative, Emotional, Practical, Contextual, Musical, Interpersonal, Intrapersonal, Bodily-Kinesthetic, Ecological, Social, Naturalistic, Sexual, for Business, Spiritual, Spatial, Mathematical or Verbal.

The Theory of Multiple Intelligences (MI) posed by Gardner (1993, 1999 & 2001) is an alternative model to the unitary concept based on a general factor (g) of intelligence, and postulates the existence of a set of eight biopsychological potential relatively independent and that are characteristic of the humankind. These potentials allow solving problems or creating valuable products in a given cultural milieu. In its initial formulation Gardner (1993) described seven intelligences: Linguistic, Logical-Mathematical, Spatial, Bodily-Kinesthetic, Musical,

Interpersonal and Intrapersonal. The Naturalistic was subsequently incorporated (Gardner, 1999), completing the eight intelligences that constitute the current configuration of the theory.

Linguistic Intelligence allows us to use words effectively and in a competent way, in both oral and written language. Musical intelligence is the capacity to perceive, discriminate, transform and express musical forms. The Logical-Mathematical Intelligence is characterized by the ability to think logically and use numbers appropriately. The Spatial Intelligence allows us to perceive the visual-spatial world accurately and carry out transformations of those perceptions. The Bodily-Kinesthetic intelligence involves the power to use the body in a coordinated manner so as to perform and to express ideas and feelings, as well as the ability to use their hands to produce and transform objects. The Intrapersonal Intelligence is the ability to act adaptively on the basis of self-knowledge. Interpersonal intelligence includes abilities to perceive and discriminate other people's feelings, intentions, reasons and moods. Finally, the Naturalistic Intelligence is the ability to observe, identify and classify objects of the natural world (Pérez & Cupani, 2008).

The effects of teaching based on multiple intelligences has received the attention of educators and researchers in recent years (Al-Balhan, 2006, Douglas et al, 2008;. Greenhawk, 1997; Mettetal, Jordan & Harper, 1997; Özdermir et al., 2006), and different instruments have been built aming to analyze and evaluate these multiple intelligences. Thus, we would highlight the Multiple Intelligences Developmental Assessment (MIDAS) Shearer (2007), the Inventory of Multiple Intelligences, by Emig (1997), or the Revised Inventory of Self-efficiency for Multiple Intelligences (IAIM.R) by Perez, Lescano, Heredia, Zalazar, Furlan & Martinez (2011). In all of them, what prevails is the self-valuation that people do over a variety of tasks and situations that are identified by each of the intelligences, and have been used in many different contexts (Al-Salameh, 2012; Llor, Ferrando, Ferrandis & Hernández, 2012). One of the concerns has been to analyze the relationship between these MI and academic performance (Bailey, 2006, Bailey, Armour, Kirk, Jess, Ian Pickup & Sandford, 2009; Ekinci, 2014; Llor, Ferrando, Ferrandiz & Hernandez, 2012 , McMahon, Rose & Parks, 2004; Ramirez Vinaccia & Suarez, 2004; Snyder, 1999). The question about analyzing the connection between MI and motor competence, as Inmamoglu & Ermis (2013) did, had been done with the sport practice. In the present study the Revised Self-efficacy Inventory for Multiple Intelligences (IAIM.R) has been used, assuming the hypothesis that the confidence that students have to solve problems related to multiple intelligences is a good predictor of their goals and preferences for certain type of activity (Pérez & Cupani, 2008).

2. RESEARCH QUESTIONS

Four research questions have been raised in this study: How is the MI profile between male and female?; Is there any relationship between academic achievement and MI?; Is there any relationship between motor competence and MI? and Are there any relationships among motor competence, academic achievement and multiple intelligences?.

3. METHOD

Participants

Four hundred and eighty children from the secondary education, ranged from 11 to 16 years old (mean age = 13.33 years old ± 1.41) participated in the study (171 girls and 309 boys). The participants were divided into three age band groups (11-12 years old, n= 161; 13-14, n= 139 and 15-16, n= 180).

Instruments

Revised Self-efficacy Inventory for Multiple Intelligences (IAIM.R) by Pérez & Cupani (2007). The questionnaire IAMI-R was created for one goal: evaluate the perceptions of self-efficacy that school age children have when they do activities related to multiple intelligences. It consists of 40 items, divided into five intelligences (Linguistic, Logical-Mathematical, Spacial, Bodily-Kinesthetic, Musical, Interpersonal, Intrapersonal and Naturalistic). Pérez & Cupani (2007) created the metric model of this instrument by a Confirmatory Factorial Analysis. The instrument demonstrated strong reliability (0.76 the lowest one and 0.92 the highest) between the categories of the test. The questionnaire is presented within a measurement system of a five points Likert scale (1 Strong disagreement – 5 Strong agreement).

*SportComp Test for secondary students (Ruiz et al., 2013).*The SportComp Test was created by Ruiz et al., (2013) as an instrument for the assessment of the coordination and motor competence in the adolescence. This test consists of 5 tasks (7 meters hopping, 7 meters jumping with feet together, 9 meters agility race, shifting on boards and side to side jumping). The test has a reliability for the 5 tasks of α=.81 (IC 95%: 0.80-0.82), while the temporal stability test-retest (in the range of 15 days) was r = 0.91 (IC 95%: 0.89-0.93).

Academic achievement. For the academic performance, it was requested to a representative and knowledgeable person of the school the annual academic performance (final) of the participants, indicating the overall score on a scale of 0-10, this value represents the average of the scores all subjects of that year. The person in charge of this work was the Tutor or Head of the School. The results were grouped into three levels of academic achievement: Good (7-10 points), Average (5-6 points) and Poor (4 or less points).

Procedure

To carry out the study it was contacted either the head of the school or the head of the Pysical Education department. They were explained about the aim of the study and asked to colaborate with it. Furthemore, an information letter was written for the parents of the students to explain them about the aim and the procedure in which the study would take place. By the signature of the sheet the parents allowed their children to participate in the study. For the motor assessment, the research team made some appointments with the PE teachers to carry

out the tests under the most favourable conditions. To fill out the questionnaire, the main researcher of the project contacted either the head of the school or the tutors to look for a better time so not to disturb the common scholar schedule.

Data analysis

The data were analyzed in a descriptive and differential way MANOVA and ANOVA including 3 (age band groups: 11-12 vs. 13-14 vs. 15-16) x 2 (gender: boys vs. girls). It was analized the relation between the different variables through the correlation and regression analyses. The level of significance was set at .05 for al statistical tests. The effect size, the confidence interval for the estimates means and other statistics were also presented. All the statistical analysis were done using the statistical software SPSS-21 (IBM, USA)

4. RESULTS

Descriptive results from the MI inventory are presented in tables 1 and 2.

Table 1. *Mean and standard deviations from the questionnaire IAMI-R in the total participants.*

	N	Mean	SD.
Linguistic Int.	480	3.87	.60
Logical-Mathematical Int.	480	4.05	.75
Bodily-Kinesthetic Int.	480	3.28	.91
Spatial Int.	480	2.85	.98
Musical Int.	480	1.93	.94
Interpersonal Int.	480	3.44	.72
Intrapersonal Int.	480	4.15	.61
Naturalistic Int.	480	3.13	.69

Table 2. *Descriptive summary from the questionnaire IAMI-R depending on the gender*

Dependent Variable	Gender	Mean	Confidence Interval at 95%.	
			Limit below	Limit above
Linguistic Int.	Female	3.96	3.86	4.07
	Male	3.80	3.73	3.87
Logical-Mathematical Int.	Female	3.99	3.86	4.12
	Male	4.10	4.01	4.18
Bodily-Kinesthetic Int.	Female	3.24	3.09	3.40
	Male	3.36	3.25	3.47
Spatial Int.	Female	3.06	2.89	3.22
	Male	2.74	2.62	2.85
Musical Int.	Female	2.00	1.84	2.16
	Male	1.88	1.77	1.99
Interpersonal Int.	Female	3.61	3.49	3.74
	Male	3.36	3.27	3.45
Intrapersonal Int.	Female	4.14	4.03	4.25
	Male	4.17	4.09	4.24
Naturalistic Int.	Female	3.04	2.92	3.16
	Male	3.11	3.03	3.20

The MANOVA analysis, taking as dependent variables the different intelligences and as independent variables (or intergroup factor) the age band group and the gender, showed that there were significant differences not only between the different age band groups (*Lambda de Wilks*: .930; F = 1.85; p = .021) but between the gender (*Lambda de Wilks*: .913; F = 4.77; p = .000). The ANOVA results showed significant differences between the gender and different intelligences including the Linguistic Intelligence (p = .012, η^2 = .015), Spatial Intelligence (p = .002, η^2 = .023) and Interpersonal Intelligence (p = .001, η^2 = .026). Those differences showed that girls had higher scores on those intelligences than boys. Regarding the age band groups, the significant differences were found in the Linguistic Intelligence (p = .009, η^2 = .023) and in the Naturalistic Intelligence (p = .005, η^2 = .025), in which the 15-16 age band group had the higher scores (Figures 1 and 2).

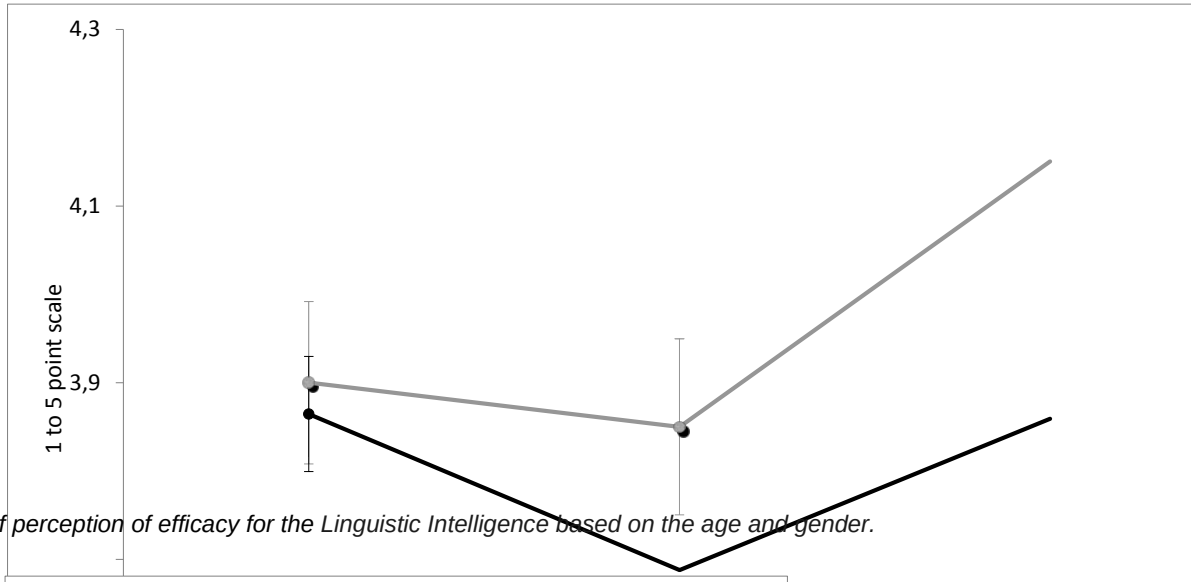

Fig. 1. *Self perception of efficacy for the Linguistic Intelligence based on the age and gender.*

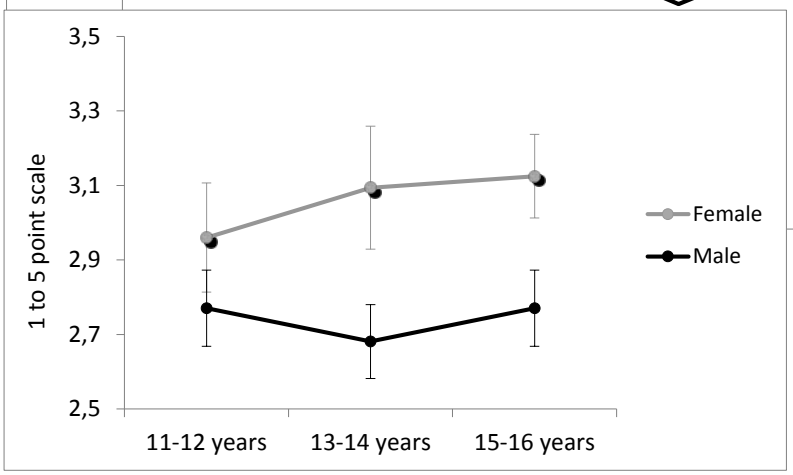

Fig. 2. *Self perception of efficacy for the Spatial Intelligence based on the age and gender.*

Tabla 3*. Means and standard deviations from the academic achievement and multiple intelligences based on the motor competence level*

	Motor Competence	Mean	SD	Confidence Interval at 95% Limit below	Limit above
Academic Achievement	Good	7.01	1.65	6.70	7.32
	Average	6.49	1.72	6.29	6.69
	Deficient	6.25	1.78	5.86	6,65
	Total	6.57	1.73	6.42	6,73
Linguistic Int.	Good	3.95	.59	3.84	4,06
	Average	3.83	.60	3.76	3,90
	Deficient	3.87	.62	3.73	4,01
	Total	3.87	.60	3.81	3.92
Logical-Mathematical Int.	Good	4,09	.83	3.93	4.25
	Average	4,04	.71	3.96	4.13
	Deficient	4.01	.78	3.83	4.19
	Total	4,05	.75	3.98	4.12
Bodily-Kinesthetic Int.	Good	3.57	.94	3.39	3.75
	Average	3.27	.86	3.17	3.37
	Deficient	2.93	.93	2.73	3.14
	Total	3.28	.91	3.20	3.37
Spatial Int.	Good	3.00	.94	2.82	3.17
	Average	2.77	.98	2.66	2.89
	Deficient	2.92	1.01	2.70	3.15
	Total	2.85	.98	2.76	2.94
Interpersonal Int.	Good	1.90	.97	1.71	2.08
	Average	1.94	.92	1.83	2.05
	Deficient	1.92	.97	1.70	2.14
	Total	1.93	.94	1.84	2.01
Interpersonal Int.	Good	3.61	.75	3.47	3.76
	Average	3.39	.70	3.31	3.47
	Deficient	3.34	.74	3.17	3.51
	Total	3.44	.72	3.37	3.50
Intrapersonal Int.	Good	4.17	.58	4.06	4.28
	Average	4.15	.61	4.07	4.22
	Deficient	4.15	.67	4.00	4.30
	Total	4.15	.61	4.10	4.21
Naturalistic Int.	Good	3.17	.69	3.04	3.30
	Average	3.15	.68	3.07	3.23
	Deficient	2.99	.73	2.83	3.16
	Total	3.13	.69	3.07	3.19

Regarding the relation between academic performance and multiple intelligences, the results showed only one positive association with the Logical-Mathematical Intelligence (r = .13; p = .003), being the best intelligence to predict the academic performance (b = .26; t = 3,06; p = .003). Furthermore, it was analyzed the relationships between motor competence and multiple intelligences through a correlation matrix between the eight intelligences and the five tasks of the test (Table 3). The results showed a weak but consistent positive association between the Bodily-Kinesthetic Intelligence and the five motor tasks (9 meters agility race: r = -.17; p = .000; Shifting on boards: r = -.12; p = .006; Seven meters hopping: r = -.17; p = .000; Seven meters jumping with the feet together: r = -.19; p = .000 and side to side jumping: r = .13; p = .003). Regarding the gender, the associations were stronger in the boys (Nine meters agility race: r = -.23; p = .000; shifting on boards: r = -.18; p = .001; Seven meters hopping: r = -.18; p = .001; Seven meters jumping witht feet together: r = -.16; p = .003 and side to side jumping: r = .-.18; p = .002), while in the girls only 7 meters jumping with feet together showed associations (r = -.21; p = .005). An interesting issue was to find out which intelligence, from those proposed by Gardner, could predict better the motor performance. The lineal regression analysis showed that only the Bodily-Kinesthetic Intelligence predicted the motor competence in a significant way (b = -.17; t = -.42; p = .001).

Finally, the results from the ANOVA including as dependent variables the academic performance and the multiple intelligences, and as the factor the level of the motor competence showed the motor competence group with the higher scores had the higher scores in the dependent variables and that only in the Musical Intelligence, the intermediate motor competence group had the higher scores. Besides, the results showed significant differences based on the level of the motor competence in the academic performance (F2,477 = 5.23; p = .006) and the Bodily-Kinesteshic Intelligence (F2,468 = 11.59; p=.000) (Fig. 3).

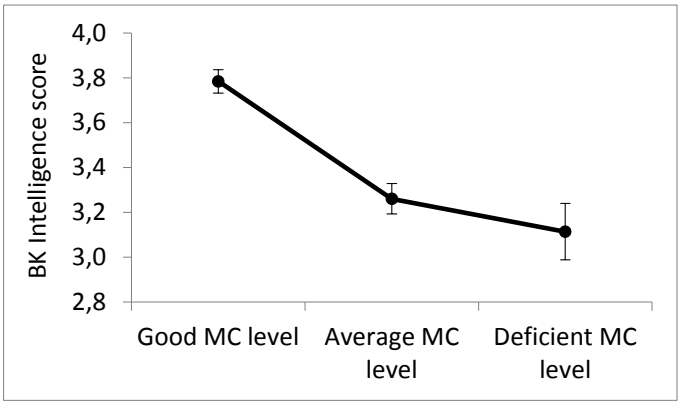

Fig. 3. *Scores for the Bodily-Kinesthetic (BK) Intelligence based on the level of motor competence (MC).*

5. DISCUSSION

It is generally accepted by MI theorists that the main feature of the model is its plural nature (Armstrong, 2000, 2003, Gardner, 2001; Menevis & Özad, 2014), since a person can display them on different levels, combinations that could also distinguish men from women. Overall the differences between boys and girls in this study were expressed as follows: Girls scored significantly higher than boys in three of the intelligences (verbal, spatial, interpersonal) which suggests that in the girls MI profile of this study, compared to boys, the visual-spatial thinking, the language, the empathy and relationships with others, predominate.

These results were similar to those obtained by Menevis & Özad (2014) with adolescents in northern Cyprus & Turkey, in which they found significant differences between boys and girls in Linguistic Intelligence, Body-Kinesthetic, Musical, Interpersonal, Intrapersonal and Naturalist Intelligences, so that the girls scored significantly higher than boys in all of them. For these authors, the reason for these differences would come from a different use of the brain by boys and girls, because while men tend to predominantly use the left side, girls would use both sides of the brain with a predominance of the right side (Menevis & Özad, 2014). In the present study, in a descriptive way, males obtained higher scores, although not significant, in logical-mathematical, bodily-kinesthetic, intrapersonal and naturalist intelligences, while girls stood out in linguistic, spatial, musical and interpersonal intelligences.

These results disagree with those usually obtained when they are asked to rate their competence in these areas, even when they are asked to value their psychometric intelligence, the most classically evaluated with intelligence tests (Furham & Baguma, 1999; Reilly & Mulhern, 1995). Especially when it is observed the

tendency for men to be valued in excess in such activities, a trend fuelled by the expectations that parents have over their children, who often feel that boys are smarter than girls (Beloff , 1992). These discrepancies are manifested when comparing these results with those found by Furham's classification, Clark & Bailey (1999) who found that boys scored higher than girls in the logical-mathematical, bodily-kinesthetic and spatial intelligences. All this leads us to think first about the features and variety of measuring tools that exist on the MI, and second, the role that culture plays in the construction of these MI as well as the attitude of adolescents valuating their competence in the different tasks that identify each of the different MI.

Regarding age, significant differences were found in two of the MI depending on the exact evolutionary moment of the participants. Schoolchildren aged 15-16 were those who scored higher than the rest in the linguistic and naturalistic intelligences. It is difficult to know the reasons behind these differences as the age, as an organizational guide of an individual's evolution, is a compendium of endogenous transformations and exogenous influences affecting the large dimensions of the people, and in this case it seems logical to think that language evolves significantly at these ages. Nor should be ignored the fact that our society is much more sensitive to the problems that affect the nature and the information and even the commitment to these issues has changed markedly in the last two decades.

Another raised issue was how Multiple Intelligences were related to academic performance (Ekinci, 2014; Hernández-Torrano, Ferrandiz, Ferrando, Prieto & Fernandez, 2014; Llor, Ferrando, Ferrandiz & Hernandez, 2012). Rehman, Shahzada, Syeda, Naumann & Rashid (2011) admit that these relationships exist, finding in their study with freshman students (male and female), relations between different MI and academic performance, taken it from their personal records .In our study only the logical-mathematical intelligence showed these significant relationships, being the intelligence that could predict better their performance.

Likewise, it was only the Bodily-Kinesthetic intelligence that showed positive relationships with the proofs of the motor tests and at the same time, it was the best one in predictions, which abound in Gardner's thesis about the role of this intelligence that involves the competence to use the body in a coordinated way so as to perform and to express. It is noteworthy that in this case the individual differences were focused on boys and girls since the girl's bodily-kinesthetic intelligence only showed associations with one of the tests, being more clear the association with all the tests in boys, which opens the possibility of different hypothesis ranging from the interest of the girls in the proposed type of work in MI inventories related to the bodily-kinesthetic intelligence, to the role that experience and the motor control is in the assessment of this intelligence.

Only one study proposed in particular in which way practicing a sport regularly does influence on multiple intelligences (Ermis & Inmamoglu, 2013). These authors found that among college students who practiced sport, compared with those who did not, they had significantly higher scores on the Linguistic, Interpersonal and Bodily-Kinesthetic Intelligences showing that the girls from the participant group had significantly higher scores on the visual-spatial and musical intelligences, and lower in the interpersonal intelligence. The Linguistic and Interpersonal Intelligences predominated among those who practiced team sports while the logical-mathematical intelligence, visual-spatial, interpersonal, intrapersonal and naturalistic predominated among those who practiced individual sports. For these authors the regular practice of sports had a positive effect on language, body and interpersonal intelligences, hence they proposed to encourage students to practice more sport.

Finally, it is interesting to mention the strategy that some researchers have suggested, grouping, either theoretically or by factorial analysis, in two or three big dimensions the 8 intelligences. Thus, Hernández-Torrano *et al*. (2014) in their study distinguished two components in the analysis of the MI to analyze the cognitive competence of schoolchildren. One academic component, or more abstract, formed by the Linguistic, Logical-Mathematical, Naturalist and Visual-Spatial intelligences, and a second component, non-academic or more practical, related to bodily-kinesthetic, musical and social intelligences which highlights the existence of two major fields of intervention, the abstract and the practical. Somehow the results of this study go in this direction, as the logical-mathematical intelligence was best in predicting academic performance, and bodily-kinesthetic intelligence was best for predicting motor performance.

In summary, it can be noted that the interest in analyzing Multiple Intelligences is gradually growing (Al-Sabbah, Mey, & Lan, 2010; Emig, 1997; Gardner & Hatch, 1989; Tracey & Richey, 2007) because of its emphasis on the individual differences and the consequences it may have for teaching (Sivrikaya, 2013). The results of this study have shown these differences, mainly between boys and girls, which should lead to consider the need for more studies that can analyze carefully the evolution of these MI, the role of culture and education in their evolution, and its effect on the selection of academic or sport activities.

A study of this nature is not without limitations. The first one refers to the sample. It was a convened sample, so not random, which limits the generalization of the results. Secondly, the multiple number of inventories that exist nowadays makes it difficult to compare different studies, and thirdly the fact that a self-report was used to assess the MI makes that it should be noted that in this group of age an underestimation or an overestimation may occur, thus affecting their responses.

It can be concluded that the logical-mathematical intelligence and bodily-kinesthetic intelligence were the best predictors of academic performance and motor achievement, respectively. There were interesting gender differences that need further research and it is necessary a research effort to develop psychometric founded MI inventories, which allow to know the type of internal structure that goes among Gardner's multiple intelligences model.

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