anales de psicología, 2014, vol. 30, nº 1 (enero), 192-200
http://dx.doi.org/10.6018/analesps.30.1.148271

ISSN edición impresa: 0212-9728. ISSN edición web (http://revistas.um.es/analesps): 1695-2294

The theory of multiple intelligences in the identification of high-ability students

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Título: La teoría de las inteligencias múltiples en la identificación de alumnos de altas habilidades (superdotación y talento).
Resumen: Este trabajo ofrece una propuesta para implementar la teoría de las inteligencias múltiples (IM) en la identificación de alumnos de altas habilidades en Educación Secundaria. Para ello se analizó la estructura interna de tres escalas para la evaluación de las IM destinadas a alumnos, padres y profesores en una muestra de 566 alumnos nominados con altas habilidades de edades comprendidas entre los 11 y los 18 años (*M* = 14.85, *DT* = 1.08). Los resultados indicaron perfiles intelectuales diferenciados dependiendo del informante estimando las IM de los alumnos. Este estudio proporcionó evidencia de la existencia de dos componentes que permiten analizar la competencia cognitiva de los alumnos más allá de las dimensiones generalmente valoradas en la escuela: un componente académico que engloba las inteligencias lingüística, lógico-matemática, naturalista y viso-espacial; y un componente no académico que comprende las inteligencias corporal, musical y social. Finalmente, se discute la utilidad de las escalas de IM para identificar alumnos de altas habilidades en educación secundaria.
Palabras clave: Inteligencias múltiples; alta habilidad; identificación; educación secundaria.

Abstract: This study provides a framework to implement the theory of multiple intelligences (MI) in the identification of high-ability students in secondary education. The internal structure of three scales to assess students' MI (students, parents and teachers' ratings) was analyzed in a sample of 566 students nominated as gifted by their teachers. Participants aged 11 to 16 years (*M* = 14.85, *SD* = 1.08). The results indicated differentiated intellectual profiles depending on the informant estimating students' MI. This study provided evidence for two components that allow us to analyze the cognitive competence of high-ability students beyond the areas commonly assessed at school: an academic component composed by the linguistic, logical-mathematical, naturalistic, and visual-spatial intelligences; and a non-academic component statistically loaded by the bodily-kinesthetic, musical and social intelligences. Convergence of the two components in the three scales was evidenced; and correlations between these components and students' objective performance on a psychometric intelligence test were found to be low. Finally, the utility of the MI scales to identify high-ability students in secondary education is discussed.
Key words: Multiple intelligences; high ability; identification; secondary school.

Introduction

It has been over 85 years since Terman conducted the first systematic study on the characteristics of high-ability individuals. Since then, many researchers have agreed on the need to assume broader perspectives of intelligence and incorporate new assessment instruments in order to capture the broad spectrum of high ability (e.g., Castelló, 2008; Gagné, 1991; Gardner, 1983; Sternberg, 1985).

Gardner's theory of multiple intelligences (MI) is one of the proposals that have aroused more interest in the distinction of different human abilities (Chan, 2008). Gardner (1999) defined intelligence as "a bio-psychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture" (p. 34). He proposed that each individual has specific strengths and weaknesses that can be conceptualized in terms of multiple abilities or intelligences. To date, Gardner has identified eight intelligences: Linguistic, logical-mathematical, naturalistic, spatial, musical, bodily-kinesthetic, intrapersonal, and interpersonal (Gardner, 1993). The value of the MI theory to expand the study of high-ability individuals has been discussed since its early establishment (see Ramos-Ford & Gardner, 1993). Recently, the MI theory has been described as a new perspective that "helps specify domains in which intellectual gifts may operate, thus describing domain-specific giftedness in terms of multiple intelligences" (Chan, 2008, p. 41). In addition, MI address domains are closely related to the areas of the school curriculum (Armstrong, 1994; Prieto & Ferrándiz, 2001), making the theory a very valuable approach for the study of high ability in school years. Thus, the MI theory has generated great expectations among psychologists and educators across the globe and applications of MI theory in the field of high ability have grown exponentially during last decades. MI theory has been used as a framework for the identification (Hernández-Torrano, Prieto, Ferrándiz, Bermejo, & Sáinz, 2013; Kuo, Maker, Su, & Hu, 2010; Llor et al., 2012; Maker, 2005) and education of high-ability students (Callahan, Tomlinson, Moon, Tomchin, & Plucker, 1995; Carpintero, Cabezas, & Sánchez, 2009; Maker, Nielson, & Rogers, 1994) in different countries.

MI profile of high-ability students from self-perspective

The MI theory has been implemented in the analysis of the cognitive profile of high-ability students. According to MI theory, assessment of students' abilities should relay on a differentiated profile of intelligences that covers the specific areas in which students can manifest their strengths and weaknesses. However, traditional psychometric tests and standardized measures of intelligence assess only a small part of the total spectrum of those abilities (Chen & Gardner, 1997). The construction of self-report intelligence instruments based on the MI theory during the last two decades, such as the Student Multiple Intelligence Profile (Chan, 2001, 2003), the Multiple Intelligence Developmental Assessment Scales (Shearer, 2007), the Multiple Intelligences

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Self-Efficacy Inventory – Revised (Pérez & Cupani, 2008), have helped researchers to expand their conclusions on the cognitive profile of high-ability students. Research in this direction has yielded contradictory results. On the one hand, Chan (2004) found that students rated their musical and interpersonal intelligences higher than other intelligences but rated lower their linguistic intelligence. On the other hand, Sánchez, Fernández, Rojo, Hernández and Prieto (2008) evidenced that students perceived higher their naturalist and logical-mathematical intelligences but lower their intrapersonal intelligence when compared with other intelligences.

MI profile of high-ability students from different perspectives

The study of the cognitive profile of high-ability students in the framework of MI theory has been extended with the consideration of the information provided by parents, teachers, and peers on students' abilities and intelligences. In this arena, studies provide consistent evidence for distinct informants estimating students' MI differently. For example, a recent study showed that teachers generally rate students' intelligences higher than students (Sanchez et al., 2008). With regards to the specific development of the different MI, the results of different studies indicate that students rate themselves lower in linguistic intelligence when compared to other informants (Chan, 2004, Sanchez et al., 2008). In addition, parents seem to perceive their children's spatial intelligence higher than other informants did; teachers and peers rate students' intrapersonal intelligence higher than parents and students; and students give themselves higher ratings on their intrapersonal and musical intelligences (Chan, 2004).

Empirical Evidence of the Theoretical Structure of the MI Theory

The independence of MI has been debated since its conception. The studies that have empirically examined its theoretical structure have yielded contradictory results. On the one hand, some studies have partially replicated the theoretical structure of MI theory with samples of average ability students via exploratory (Chan, 2001; Ferrándiz, Prieto, Ballester, & Bermejo, 2004; Perez & Cupani, 2008) and confirmatory factor analysis (Chan, 2006; Perez & Cupani, 2008). On the other hand, a considerable number of studies have provided little or no empirical evidence on the theoretical structure of the MI theory. For example, Almeida et al. (2010) suggested that MI scores assessed by performance-based tasks converged into a single factor, which could be identified with the *g factor*. Bennet (1997) investigated the underlying dimensionality in the participants' self-estimates of their MI and concluded that two distinct factors, corresponding to western stereotypes about sexes, were underlying participants' responses. The first factor comprised the mathematical, spatial and body-kinesthetic intelligences, while the second factor included the verbal, musical and personal intelligences. Similarly, Furnham & Bunclark (2006) analyzed the theoretical structure of the theory in a sample of parents who self estimated their own MI. The results indicated that the five cognitive intelligences (i.e., linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic) loaded in one factor, and the two non-cognitive intelligences (i.e., intrapersonal and interpersonal intelligences) loaded in another factor. Other studies have provided empirical evidence that a three-factor structure underlie the empirical structure of MI theory. For example, Furnham, Fong and Martin (1998) proposed a factor structure composed by a verbal factor (linguistic intelligence), a mathematical factor (mathematical and spatial intelligences) and a musical factor (musical and bodily-kinesthetic intelligences), as it has been found in other studies (Furnham & Fong, 2000). Similarly, Campbell, Campbell and Dickinson (2004) proposed to group the MI into three domains: (a) the object-free: musical and verbal intelligence; (b) the object-related: logical-mathematical, visual-spatial, bodily-kinesthetic, and naturalist; and (c) the personal, which includes the interpersonal and intrapersonal intelligences.

The Identification of High Ability from the MI Theory

The convergence between different approaches for assessing intelligence and performance is a major issue in the identification of high-ability students. Some studies have examined the relation between perceived intelligence and psychometric intelligence. For example, Furnham and Chamorro-Premuzic (2004) showed a significant relationship (r = .30) between these two constructs. Other studies have examined the predictive ability of perceived MI over general perceived intelligence. In this sense, Furnham, Tang, Lester, O'Connor and Montgomery (2002) indicated that the best predictors of one's overall intelligence estimates were logical-mathematical, verbal, and spatial intelligences. In a similar study, Furnham and Chamorro-Premuzic (2005) evidenced that verbal, mathematical, and intrapersonal perceived intelligences were consistently the best predictors of global perceived intelligence for children, parents, and grandparents. However, other studies have failed to provide evidence on the predictive ability of the MI over academic performance (e.g., Chan, 2001; Kiggundu, 2011). Few studies have examined the correspondence between MI theory and other theoretical approximations in the identification of high-ability students. Llor et al. (2012) have provided evidence that MI theory provides valuable insights for understanding the cognitive configuration of high-ability students. This study showed that the implementation of MI theory allow us to identify different strengths abilities and talents beyond those measured by traditional intelligence tests, which otherwise would not be identified.

There is a need for assessment procedures and tools for studying the broad spectrum of high ability and identifying the wide range of strengths and abilities beyond the variables considered by traditional intelligence tests. According to the literature review, MI theory seems an appropriate framework for this purpose. The purpose of this study is to provide a framework to implement the theory of MI in the identification of high-ability students in secondary education analyzing the internal structure of three recently developed scales to assess students' MI based on students, parents and teachers' ratings.

Method

Participants

Participants were 566 secondary school students (46.5% girls) nominated as high-ability students by their teachers in the Region of Murcia (Spain). The average age of the participants was 14.06 (SD = 1.08); ages ranged from 12 to 16. With regards to educational level, the sample was distributed as follows: 231 (40.8%) were seventh-graders, 19 (3.4%) eighth-graders, 295 (52.1%) ninth-graders, and 21 (3.5%) tenth-graders. Additionally, 536 parents and 443 teachers participated in the study and estimated students' IM.

Instruments

Multiple intelligences

The Screening Scales for the Evaluation of Multiple Intelligences (SSEMI; Llor et al., 2012) were used to assess teachers, parents and students perceptions of students' MI. The SSEMI have been translated and adapted from Armstrong's scales to assess MI (Armstrong, 1994), following the international standards promulgated by the International Test Commission (Hambleton, Merenda, & Spielberger, 2005). The three rating scales include 28-item in which informants (teachers, parents, and students) express their agreement about the characteristics and behaviors of the students on a 4-point scale ranging from 1 (never) to 4 (always), in terms of Gardner's MI. They allow informants to assess seven areas where students can show strengths or weakness: linguistic (ability to effectively manipulate language to express oneself when writing and speaking), logical-mathematical (ability to detect patterns, reason deductively, and think logically), naturalist (ability to identify and classify patterns in nature), spatial (ability to manipulate and create mental images to solve problems), musical (ability to recognize and compose musical pitches, tones, and rhythms), bodily-kinesthetic (ability to use one's mental abilities to coordinate one's own bodily movements), and social intelligences—intrapersonal and interpersonal intelligences from the original scale were combined (ability to understand and discern the feelings and intentions of oneself and others).

Intellectual aptitudes

The Differential Aptitude Test—Level 1 (DAT-5; Bennet, Harold, & Wesman, 2000) was used to assess five IA: verbal (ability to find relationships between words), numerical (ability to understand numerical relationships and handle numerical concepts), abstract (ability to discover an implicit rule that relates a series of non-verbal designs), mechanical (ability to understand basic mechanical principles), and spatial reasoning (ability to imagine and rotate an object in three dimensions).

Procedure

This study was part of a larger investigation aimed to analyze several instruments and procedures based on different theories of intelligence for the identification of high-ability students in secondary education (see Ferrándiz et al., 2010). This investigation was divided into three phases. In the first phase, secondary school teachers were invited to participate in an identification process for secondary high-ability students. Specifically, they were asked to nominate students who would qualify to participate in an extracurricular program for high-ability students. In total, teachers nominated 566 high-ability students. In the second phase, teachers were asked to rate the MI and other social and emotional variables of the nominated students. Also, parents and students were asked to evaluate nominated students' MI and social and emotional facets. In the third phase, the 566 nominated students were invited to complete two performance tests to assess their intellectual aptitudes and divergent thinking. The first and second phases of the investigation were completed in two sessions of one hour and thirty minutes each. Sessions were scheduled in different days within the same week. MI rating scales were completed in the first session.

Data Analysis

Data analysis was performed using IBM SPSS Statistics Version 19. Descriptive analysis provided preliminary information about students' MI profile. The internal consistency of the scales was assessed with the Cronbach Alpha reliability coefficient. Since most variables had a non-normal distribution according to the Kolmogorov-Smirnov's test, a Friedman test was conducted to evaluate the significance of the differences between the estimations of students, parents, and teachers on students' MI. Post-hoc analyses were conducted using Wilcoxon signed rank tests and controlling for the Type I errors across these comparisons using the Bonferroni correction at a 0.05/3 = .0017 level. Principal components analyses were performed to identify groupings among the seven multiple intelligences rated by students, parents, and teachers. Components were selected on the basis of eigenvalue, scree plot analysis, and careful consideration of interpretability of the structure. The convergent validity of the MI scales was evaluated via Multitrait-

Multimethod matrix. To evaluate the discriminant validity of the MI scales, the correlations between the MI scales and a standardized instrument of intellectual aptitudes were analyzed.

Results

Descriptive analysis

Table 1 includes the descriptive statistics for students, parent, and teachers' perceptions on students' MI. The results evidenced a fairly good distribution of the participants' responses. Scores were distributed across the minimum and maximum values in the range of responses (range 4-16). In general, informants' mean scores were high for all the intelligences. Teachers' estimated students' MI higher than parents and students did for most of the intelligences. Further examination of the results indicated that students, parents and teachers rated students' social intelligence higher than other intelligences. Moreover, the standard deviation in this dimension was the lowest when compared to other variables, suggesting that all informants probably agreed that nominated students have a good social and emotional competence. The lowest ratings were for linguistic intelligence in the students' scale (M = 10.94, DT = 2.18), and for bodily-kinesthetic intelligence in the parents and teachers' scale (M = 10.83, DT = 2.35; M = 11.26, DT = 2.29; respectively). The results of the Kolmogorov-Smirnov test indicated that most variables had a non-normal distribution ($p < .0005$).

Internal consistency coefficients for students, parents, and teachers' MI scores are presented in Table 1. The Cronbach's alpha coefficients for students' MI scores were acceptable for naturalistic and musical intelligence (α = .66, α = .73, respectively), but low for the other intelligences (α < .50). The coefficients for the parents' MI scores were found to be low for *linguistic* and *spatial intelligences* (α = .53, α = .40, respectively), while moderate for the other intelligences (.61 < α < .70). The coefficients for the teachers' MI scores were satisfactory for all the intelligences (α > .70), except for the *linguistic* and *spatial intelligences* (α = .68, α = .61, respectively).

Inferential Analyses

A Friedman test was conducted to evaluate the significance of the differences between the estimations of students, parents, and teachers on students' MI. Post-hoc analyses were conducted using Wilcoxon signed rank tests and controlling for the Type I errors across these comparisons using the Bonferroni correction at the .0017 level (see Table 2).

Application of Friedman's test evidenced that informants' estimations of students' linguistic intelligence were significantly different, $\chi^2(2)$ = 132.334, p = .0005. Post-hoc analyses evidenced that teachers rated linguistic intelligence higher than students did (Z = -10.617, $p \leq .0005$). Parents also rated their children's linguistic intelligence higher than the students themselves (Z = -10.307, $p \leq .0005$). No significant differences were found between teachers and parents' estimations on this dimension (Z = -1.958, p = .05).

For the logical-mathematical intelligence, statistically significant differences among students, parents, and teachers' estimations were also manifested, $\chi^2(2)$ = 130.497, $p \leq .0005$. Specifically, teachers estimated their students' logical-mathematical intelligence higher than parents (Z = -10.889, p < .0005) and students themselves (Z = -10.102, p < .0005). Additionally, students rated their logical-mathematical intelligence higher than their parents (Z = -2.523, p < .012).

Table 1. Descriptive Statistics and Internal Consistency Coefficients for the Screening Scales for the Evaluation of Multiple Intelligences

	Items	Min.	Max.	*M*	*SD*	α
Student' MI						
Linguistic	4	5.0	16.0	10.9	2.18	.43
Logical-Mathematical	4	5.0	16.0	11.3	2.16	.49
Naturalist	4	4.0	16.0	11.8	2.43	.66
Musical	4	6.0	16.0	12.0	2.59	.73
Spatial	4	4.0	16.0	11.3	2.25	.40
Bodily-Kinesthetic	4	5.0	16.0	11.4	2.02	.38
Social	4	5.0	16.0	12.2	1.86	.35
Parent' MI						
Linguistic	4	6.0	16.0	12.0	2.14	.53
Logical-Mathematical	4	4.0	16.0	11.0	2.58	.63
Naturalist	4	4.0	16.0	12.2	2.32	.65
Musical	4	4.0	16.0	11.5	2.67	.64
Spatial	4	5.0	16.0	11.6	2.40	.40
Bodily-Kinesthetic	4	4.0	16.0	10.8	2.35	.61
Social	4	7.0	16.0	13.4	2.17	.70
Teacher' MI						
Linguistic	4	5.0	16.0	12.2	2.38	.68
Logical-Mathematical	4	6.0	16.0	12.5	2.31	.72
Naturalist	4	5.0	16.0	13.0	2.27	.76
Musical	4	4.0	16.0	11.9	2.42	.74
Spatial	4	5.0	16.0	12.6	2.13	.61
Bodily-Kinesthetic	4	4.0	16.0	11.2	2.29	.72
Social	4	5.0	16.0	13.2	2.18	.74

Note. Min. = Minimum; *Max.* = Maximum; *M* = Mean; *SD* = Standard Deviation; α = Cronbach's alpha.

The analysis for the naturalist intelligence indicated that the differences between the estimations of the three informants were statistically significant, $\chi^2(2)$ = 112.450, $p \leq .0005$. Again, post-hoc analyses evidenced that teachers had a higher perception than parents and students in this intelligence (Z = -6.356, $p \leq .0005$; Z = -9.981, p < .0005, respectively). However, parents rated their children's naturalist intelligence higher than students themselves in this case ($Z = -5.145$, $p < .0005$).

The *spatial intelligence* was also estimated significantly different by the three informants, $\chi^2(2) = 112.450$, $p \leq .0005$. Teachers gave nominated students a higher rating in this intelligence than students and parents did ($Z = -10.338$, $p < .0005$; $Z = -7.905$, $p \leq .0005$, respectively). Also, parents rated higher than students their spatial intelligence ($Z = -2.607$, $p < .009$).

The estimation of students' *musical intelligence* also evidenced statistically significant differences among the three groups, $\chi^2(2) = 24.678$, $p \leq .0005$. Results indicated that students and teachers rated this intelligence significantly higher than parents ($Z = -5.258$, $p < .0005$; $Z = -3.115$, $p = .002$, respectively). No statistically significant differences between students and teachers' rating for musical intelligence were found ($Z = -0.514$, $p = .607$).

With regards to *bodily-kinesthetic intelligence*, results showed a statistically significant difference for students, parents, and teachers' estimations, $\chi^2(2) = 24.409$, $p \leq .0005$. Again, students and teachers rated this intelligence significantly higher than parents ($Z = -4.854$, $p < .0005$; $Z = -3.570$, $p \leq .0005$, respectively), and no statistically significant differences between students and teachers' estimations were found ($Z = -1.373$, $p = .170$).

Finally, the results evidenced statistically significant differences among students, parents, and teachers' estimations on students' *social intelligence*, $\chi^2(2) = 142.529$, $p \leq .0005$. Specifically, teachers and parents rated significantly higher their students and children's social intelligence when compared with students' ratings ($Z = -9.226$, $p < .0005$; $Z = -10.520$, $p \leq .0005$, respectively). Post-hoc analyses indicated no significant differences between teachers and parents' estimations ($Z = -1.206$, $p = .228$).

Table 2. Summary of the Analyses of Variance for Screening Scales for the Evaluation of Multiple Intelligences.

	df	χ^2	Summary
Linguistic	2	132.334*	1 < 2 = 3 > 1
Logical-Mathematical	2	130.497*	1 > 2 < 3 > 1
Naturalist	2	112.450*	1 < 2 < 3 > 1
Spatial	2	112.450*	1 < 2 < 3 > 1
Musical	2	24.678*	1 > 2 < 3 = 1
Bodily-Kinesthetic	2	24.409*	1 > 2 < 3 = 1
Social	2	142.529*	1 < 2 = 3 > 1

Note. 1 = Students, 2 = Parents, 3 = Teachers
*$p < .001$

Factorial Analysis

Principal components analyses were performed to identify groupings among the seven multiple intelligences rated by students, parents, and teachers. Table 3 summarizes the results of the principal component analyses with varimax rotation on the student, parent, and teacher' MI scales.

Table 3. Principal Component Analyses with Varimax Rotation on the Screening Scales for the Evaluation of Multiple Intelligences.

	Students' MI		Parents' MI		Teachers' MI	
	I	II	I	II	I	II
Linguistic	.62		.67		.79	
Logical-Mathematical	.83		.87		.86	
Naturalist	.83		.79		.86	
Spatial	.41	.55	.71		.56	.55
Bodily-Kinesthetic		.55		.66		.83
Musical		.78		.79		.78
Social	.47	.54		.67	.53	.54

The Bartlett's test of sphericity and the Kaiser-Meter-Olkin (*KMO*) test of sampling adequacy were used to determine the appropriateness of the data for principal component analysis in the students MI scale. The *KMO* value was .796 and the Bartlett's test was significant ($\chi^2 = 2784.9$; $df = 21$; $p < .001$), suggesting that the data was appropriate for principal component analysis. The analysis yielded a single component with value greater than 1.0, which accounted for 40.37% of the total variance. This component was statistically loaded with all the dimensions of the scale: *linguistic, logical-mathematical, naturalist, spatial, musical, bodily-kinesthetic, and social intelligences*. However, based on a careful examination of the scree plot, and substantive considerations regarding the structure and interpretability of the one- to three-component solutions, the two-component solution was considered the best to interpret the scores in our sample, which accounted for 54.19% of the total variance (see Figure 1). Component 1 was statistically loaded with the *linguistic, logical-mathematical, naturalist* and *social* y *spatial intelligences,* and accounted for 40.37% of the total variance. Component 2 was statistically loaded with the *musical, spatial, bodily-kinesthetic,* and *social intelligences,* and accounted for 13.80% of the total variance.

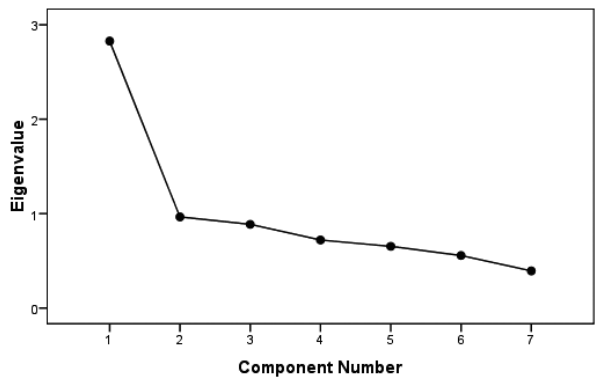

Figure 1. Scree Plot of the Principal Component Analysis on the Students' MI Scale.

The Bartlett's test of sphericity and the Kaiser-Meter-Olkin (*KMO*) test of sampling adequacy were used to determine the appropriateness of the data for principal component analysis in the parents MI scale. The *KMO* value was

.825 and the Bartlett's test was significant ($\chi^2 = 1054.8$; $df = 21$; $p < .001$), suggesting that the data was appropriate for principal component analysis. The analysis yielded two components with value greater than 1.0, which accounted for 59.69% of the total variance (see Figure 2). Component 1 was composed of linguistic, logical-mathematical, naturalist, and spatial intelligences, and accounted for 45.20% of the total variance. Component 2 was composed of musical, bodily-kinesthetic, and social intelligences and accounted for 14.49% of the total variance.

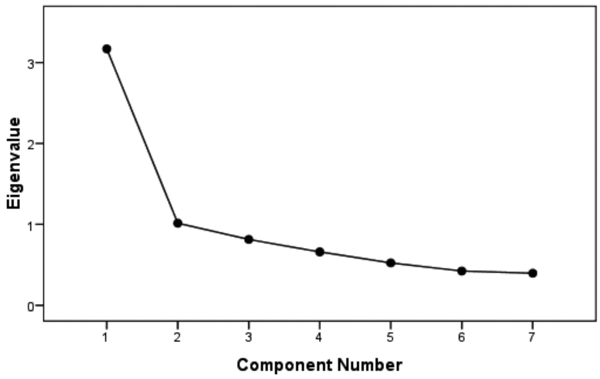

Figure 2. Scree Plot of the Principal Component Analysis on the Parents' MI Scale.

The Bartlett's test of sphericity and the Kaiser-Meter-Olkin (*KMO*) test of sampling adequacy were used to determine the appropriateness of the data for principal component analysis in the teachers MI scale. The *KMO* value was .867 and the Bartlett's test was significant ($\chi^2 = 1707.9$; $df = 21$; $p < .001$), suggesting that the data was appropriate for principal component analysis. The analysis yielded a single component with value greater than 1.0, which accounted for 40.37% of the total variance. This component was statistically loaded with all the dimensions of the scale: *linguistic, logical-mathematical, naturalist, spatial, musical, bodily-kinesthetic, and social intelligences*. However, based on a careful examination of the scree plot, and substantive considerations regarding the structure and interpretability of the one- to three-component solutions, the two-component solution was considered the best to interpret the scores in our sample, which accounted for 67.58% of the total variance (see Figure 3). Component 1 was statistically loaded with linguistic intelligence, logical-mathematical, naturalist, spatial and social intelligences, and accounted for 55.57% of the variance. Component 2 was statistically loaded with spatial intelligence, bodily-kinesthetic, musical, and social intelligences, and accounted for 12.01% of the variance. This structure is very similar to that found in students' MI scale, suggesting that students and teachers share a similar view on the organization of students' multiple abilities.

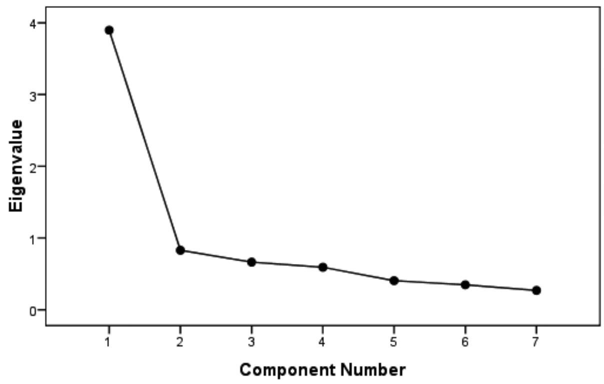

Figure 3. Scree Plot of the Principal Component Analysis on the Teachers MI Scale.

Convergent and Discriminant Validity

The results from the principal component analyses evidenced the existence of two very similar components on the three MI scales, which may suggest that both components may refer to the same information in the three MI scales. To test this hypothesis we performed an analysis of convergent validity through a Multitrait-Multimethod matrix (*MTMM*; Campbell and Fiske, 1959). In the *MTMT* framework, the convergent validity coefficients are the correlations between measures of the same trait that are obtained with different measurement methods. There is evidence of convergent validity when the correlations between the exponents of the same trait measured with different techniques are statistically significant and higher than the correlations between the exponents obtained with different traits scaled with the same technique.

Table 4. Multitrait-Multimethod Matrix of the Screening Scales for the Evaluation of Multiple Intelligences.

	1	2	3	4	5	6
Students						
1. Academic	-					
2. Non-Academic	.00	-				
Parents						
3. Academic	**.57***	.03	-			
4. Non-Academic	-.02	**.49***	.00	-		
Teacher						
5. Academic	**.38***	-.05	**.32***	-.01	-	
6. Non-Academic	-.04	**.31***	-.06	**.34***	.00	-

*$p < .001$

As shown in Table 4, correlations between measures of the same traits (i.e., academic and non-academic components) assessed by different techniques (i.e., students, parents, and teachers) were positive and statistically significant ($p < .001$). In addition, these correlation coefficients were higher than those obtained for different traits assessed by the same techniques, supporting the idea that these components could be grouped into two general components, representing an academic component that includes information from students, parents and teacher on scholastic talent areas such as reading, writing, math, science, and other academic domains; and a non-academic component that includes information from students, parents and teachers on different talent areas such as art, music, sports, and other non-academic domains.

A correlation analysis between the academic and non-academic components derived from the principal component analysis and standardized instrument of intelligence (i.e., DAT-5) was performed to investigate the discriminant validity of the MI scales (see Table 5). Overall, correlations between the academic and non-academic components of the MI scales and the variables assessed by the performance-based intelligence test were found to be low. However, further analysis of the correlation matrix evidence some statistically significant relationships. First, low correlations between the parents' academic component and the dimensions of the performance-based intelligence test were shown ($r = .15, p < .01$, $r = .29, p < .01$). Second, statistically significant correlations between the teachers' academic component and the verbal and numerical dimensions of the DAT-5 were evidenced ($r = .24$ and $r = .25, p < .01$, respectively). Similarly, students' academic component showed statistically significant correlations with the verbal, numerical, spatial, and mechanical dimensions of the objective test ($r = .13$ to $r = .17$, $p < .01$). Third, statistically significant and negative correlations between the non-academic components of the three scales and some dimensions of the measure of objective students' performance were evidenced, especially for numerical reasoning ($r = -.12$ to $r = -.17, p < .01$).

Table 5. Correlation Matrix for the Screening Scales for the Evaluation of Multiple Intelligences and the Differential Aptitude Test (DAT-5)

Reasoning	Students		Parents		Teachers	
	Acad.	Non-Acad.	Acad.	Non-Acad.	Acad.	Non-Acad.
Verbal	.13*	.05	.29**	-.06	.24**	-.05
Numeric	.16*	-.10	.22**	-.17*	.24**	-.15*
Abstract	.08	-.01	.15*	-.06	.06	-.10
Mechanical	.17*	-.04	.28**	-.07	.09*	-.12*
Spatial	.14*	.06	.24**	.02	.08	-.02

Note. Acad. = Academic, Non-Acad. = Non-Academic
$*p < .05$, $**p < .01$

Discussion

This paper provides a proposal to implement Gardner's MI theory in the identification of high-ability students in secondary education using three scales for the assessment of students, parents, and teachers' estimates of students' MI.

The analysis of the MI profile of high-ability students from the perspectives of students, parents, and teachers yielded the following conclusions. First, the three informants estimated that students' MI were relatively high. This may be explained taking into account that participants were nominated as high-ability students by their teachers. Second, teachers rated students' competence more highly than parents and students themselves –especially on the academic intelligences– in line with previous research in this area (e.g., Sanchez et al., 2008). A plausible explanation for this may be that, while teachers can compare students' abilities between different students, parents evaluate their children in absolute terms with no comparison between students. Third, parents and teachers estimated students' *linguistic intelligence* higher than students themselves. However, students rated their *social* and *musical intelligence* higher than parents and teachers did, while students rated their *linguistic intelligence* the lowest. These results reproduce exactly those obtained by Chan (2004) in a sample of high-ability students in Hong Kong, which may be an indicator of the consistency of these data in different cultures and countries. Four, students, parents, and teachers rated students' *social intelligence* the highest. This may be an indicator of the appropriate socio-emotional competence of high-ability students as has been evidenced consistently in previous studies (Prieto & Ferrando, 2008; Schewean, Saklofske, Widdifield-Konkin, Parker, & Kloosterman, 2006; Zeidner, Shani-Zivotich, Matthews, & Roberts, 2005).

The study of the internal structure of the MI scales yielded the following conclusions. First, the estimations of the three informants (i.e., students, parents, and teachers) on students' MI fall into two general components: an academic or abstract component, which includes the *linguistic*, *logical-mathematical*, and *naturalistic intelligences*; and a less academic or more practical component, which includes the *musical*, and *bodily-kinesthetic intelligences*. These components are consistent with previous studies concluding that a two-factor structure underlies the empirical structure of MI theory (e.g., Bennet, 1997; Furnham & Bunclark, 2006). Second, *spatial* and *social intelligences* statistically loaded in both the academic and non-academic components, suggesting that they share common characteristics with the two components. In other words, the ability to accurately perceive the visual and spatial world, to be aware of oneself, to understand one's strengths and weaknesses, and to discern and respond appropriately to others' moods, feelings, temperaments and motivations, are critical in the both the academic and non-academic contexts.

Correlations between the students, parents, and teachers' estimations of students' MI and students' objective performance on the aptitude test were found to be low. The lack of such a relationship in our study could be due to the different nature of the instruments themselves. MI scales assess the student's ability to solve problems that have a certain value in a specific culture in different areas (Gardner, 1983), while the DAT-5 assesses readiness to learn and perform well in a particular area or domain (Corno et al., 2002). Furthermore, MI scales assess the estimations of several informants (i.e., students, parents and teachers) on students' abilities, while the aptitude test assesses students' objective performance in different areas. Additionally, each instrument assesses different areas or domains. MI scales assess a wide range of areas, including some traditionally academic domains (i.e., linguistic, logical-mathematical, and naturalistic) and other less academic domains (i.e., bodily-kinesthetic, musical, and social). The aptitude test is more limited in this regard and only assesses cognitive abilities. This could explain why higher correlations occurred between the academic component of the three MI scales and the verbal and numerical aptitudes in the performance-based test. Finally, the instruments also differ in how they assess the strengths of the students, with the MI scales assessing students in a more practical and natural environment, and the DAT-5 assessing students through decontextualized and abstract tasks (Hernández-Torrano et al., 2013).

Overall, the data presented here evidence that MI theory is a valuable construct for the study and identification of high ability students. Our study offers two components that allow us to analyze the broad spectrum of high skill beyond the information provided by conventional intelligence and aptitude tests. These components can be used to identify strengths and talents in the academic areas but also high-ability students who excel in less academic areas such as sports, dance, music, or the social area. Furthermore, the possibility of collecting information from the perspective of different informants (i.e., students, parents, and teachers) greatly enhances the identification process. Thus, this procedure covers the information provided by the teacher about the school context, by the parents about the family context, and by the student about his/her personal context. Additionally, the application and interpretation of the MI scales is very easy, facilitating the identification process. The academic and nonacademic components converge in the three MI scales, which yields very practical effects when analyzing the student's cognitive profile and comparing the information provided by distinct informants. Future studies should be directed toward improving the internal consistency of the scales, especially the scale for assessing students' MI. Finally, the approach presented here allows taking into account detailed profiles regarding different intelligences, which can help all individuals reach their maximum development potential, both in the academic and non-academic contexts.

Acknowledgements.- This work was supported by Fundación Séneca, Agencia de Ciencia y Tecnología de la Región de Murcia [18563/PD/11; 11896/PHCS/09] and Ministerio de Ciencia e Innovación, Gobierno de España [EDU2009-12925].

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(Article received: 05-03-2012; reviewed: 03-04-2012; accepted: 27-02-2013)