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Sylvia Sastre-Riba¹

Abstract

This study aims to provide a better understanding of high intellectual abilities and of how to address the educational needs of those who possess such abilities. Within the emergent paradigm, high intellectual abilities are understood as multidimensional and as the result of lifetime development; that is, not only are they the result of their neurobiological basis but also of the interrelation among opportunity, personality, psychosocial factors, and individual effort. This study describes the basis of a program of extracurricular enrichment and its interrelation with research procedures and results.

Keywords

high intellectual ability, crystallization, intellectual profiles, problem solving, metacognition, enrichment program, research

Among other advantages, high intellectual ability has personal value, because it is a determining influence in the life of the people who are endowed with it, and social value, given their potential to contribute to the scientific, technological, and artistic development of society as well as to promote thinking throughout history (Besjes-de Bock & Ruyter, 2011).

Even though over the last decades interest and research on its nature and education has increased, it is still a little studied field, with discrepancies in methodology and naming of the phenomenon under study (Dai, Swanson, & Cheng, 2011). Consequently, there still exists some conceptual blurriness (Dai, 2005; Dai & Renzulli, 2008; Gagné, 2005) that results in imprecision about its nature and expression forms, equivocal

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identification processes, and confusion with other atypical developmental paths, such as attention-deficit hyperactivity disorder (Hartnett, Nelson, & Rinn, 2004), the *idiot savants* (Winner, 2000), or learning disorders. Its development and cognitive functioning are not well known either (Steiner, 2006); thus, education professionals feel they are poorly trained (Miller, 2004), conceptually confused (Sastre-Riba, 2004) and doubtful about the reliability of educational interventions.

The status of the issue gives rise to misleading diagnostic practices that generate false expectations and psychoeducational practices of uncertain effectiveness (VanTassel-Baska, 2006). This may lead to possible personal maladjustments, thus affecting the well-being and life quality of these individuals, who will likely fail to achieve their full potential (Betts & Neihart, 2004).

From an up-to-date scientific perspective, the main feature of high ability is a high intellectual potential (Matthews & Foster, 2006), with multidimensional configuration that must crystallize throughout development, and such cognitive functioning that makes the high-intellectual capacity individual stand out from other individuals with average intellectual ability. Therefore, being a person with high intellectual ability is a function resulting from such a developmental process, its neurobiological substrate, and incident psychosocial variables and education, which determine its more or less stable and optimal manifestation (Dai & Renzulli, 2008).

Thus, it is relevant to have an efficient and responsible educational practice available that addresses the model proposed by VanTassel-Baska, MacFarlane, and Feng (2008). According to this model, the use of research-based practices together with the evaluation of their results is essential. This means that a consistent theory that accounts for the nature, characteristics, and development of high intellectual abilities is needed, one that allows different effective curricular or extracurricular educative adaptations for the optimal expression of giftedness and talent development.

This situation is also a reality in Spain, particularly because research and educational experience in the field are less developed than in other countries, even though there is legislation regarding awareness within the education system toward high intellectual ability students. There are some specialized magazines (e.g., *Faisca*, *Revista de Altas Capacidades*), consolidated research groups in some universities (e.g., Universitat Autònoma de Barcelona, Universidad Complutense de Madrid, Universidad de Murcia, Universidad de Santiago de Compostela, Universidad de La Rioja, etc.), and researcher associations (e.g., the Spanish Association for the Study of Giftedness or *Sociedad Española para el Estudio de la Superdotación*), but these groups have little influence on the education system in terms of implementing initiatives such as a differentiated curriculum, curricular enrichment, and extracurricular enrichment, which are scientifically founded and assess outcome effectiveness. The program is, then, fragile, yet there is much interest in high ability. This interest drives toward improving the situation and contributes on occasions by promoting and disseminating initiatives that are based more on conceptual blurriness than on scientific reality. These initiatives generate equivocal diagnostics and intervention suggestions that may con-

tribute to fostering of false expectations and personal maladjustments instead of well-being and the expression of an individual's high ability.

To clarify the concept and nature of high ability, increase its value, and promote effective educational practices using a systematic approach (VanTassel-Baska & Wood, 2010), the University of La Rioja, with the assistance of the Education Department of the La Rioja Government (*Consejería de Educación del Gobierno de La Rioja*), is implementing an extracurricular enrichment program. This program is closely linked to its supporting research and is being assessed for its cognitive and personal effects as well as for the satisfaction generated in its participants. This extracurricular enrichment program is closely tied to those being carried out at other universities, such as the Complutense University of Madrid (Pérez, 2006), and other European entities such as the Austrian Research and Support Center for the Gifted and Talented (ÖZBF). Teacher training is also promoted within the university curriculum and through specific courses and seminars, some of which are supported by the education administration.

This extracurricular enrichment program (UR-ARNAC), which is based on a concept of giftedness and talent development according to the new paradigm proposed by Dai (2005), consists of three interrelated components: (a) research into the nature and functioning of high abilities, their differential manifestations, and corresponding stability; (b) extracurricular enrichment activities; and (c) assessment of program effectiveness and the satisfaction of the participants and their families. On the basis of these components, according to VanTassel-Baska, MacFarlane, and Feng's (2008) proposal, it is necessary to examine the starting input to high intellectual ability development, the extracurricular activity, and the optimal output achieved.

The following items provide a basic outline of the components that lie at the foundation of the program.

a. High intellectual ability: concept, nature, and functioning

High intellectual ability is understood beyond the traditional paradigm (monolithic and centered on intellectual quotient) toward an emerging (Dai, 2005), interdisciplinary, multidimensional, and neuropsychological paradigm that has been changed the focus of interest from who has high ability to how his or her mind works (Steiner & Carr, 2003; Sastre-Riba, 2011; Treffinger, 2009). In doing this, different manifestations such as giftedness and talent are differentiated and shown through multidimensional intellectual profiles that help us understand how high intellectual ability crystallizes throughout development. This emerging paradigm may clarify the concept and functioning of high intellectual ability (Matthews & Foster, 2006), disassociating it from existing myths (see special issue of *Gifted Child Quarterly*, Treffinger, 2009, or Grigorenko, 2011), the majority of which refer to psychoeducational intervention and its effectiveness.

High intellectual ability is expressed in differentiated profiles of giftedness or talent with differentiated resolutive functions (Sastre-Riba & Domènech, 2003) not only

between them but also in regard to average intellectual ability, quantitatively (larger number of intellectual resources or information) and qualitatively (management of these resources and information).

To discern between giftedness and talent, Castelló's (2008) criteria were followed. Thus, giftedness is characterized as an intellectual ability globally found above the 75th percentile in all intellectual functioning domains, both convergent (logical–deductive) and divergent (creativity), which assumes that its configuration is multidimensional. Talent consists of a very high ranking (>90th percentile) in one or several intellectual skills, but not all. It may be simple (i.e., verbal talent) or complex (i.e., double, triple or quadruple talent).

The functioning of giftedness is of particular interest. It is characterized by high global cognitive ability and wide availability of management resources and information interrelation, more than of information quantity. The intellectual functioning of talent is specific and vertical (higher information availability), determined by its configuration in one or several skills and types.

From this perspective, and although high intellectual ability development is not fully understood, it is of great interest to learn not only about its neurobiological substrate, which enables differential functioning of the mind (Jaušovec, 2000; Jaušovec & Jaušovec, 2004) under the neural effectiveness theory, but also about the psychosocial dynamics that may hinder or potentiate its manifestation (Heller, 2005). The neural effectiveness theory of functioning implies the selective and simultaneous activation of zones related to task resolution (Jaušovec & Jaušovec, 2004), reduced cortical metabolism (Jin, Kwon, & Jeong, 2006), higher myelination, synaptic network enrichment, and so on. These characteristics supplement the functional explanation about differences in effective problem resolution and steps to achieve it between individuals with high intellectual ability are modulated by personal and psychosocial adjustment variables.

Expression of high intellectual ability demands good cognitive management. A number of researchers (Steiner, 2006; Synder, Nietfeld, & Linnenbrink-Garcia, 2011) postulate that gifted and talented children show significant differences in regard to average intellectual ability in problem resolution effectiveness and strategies related to metacognitive regulation, and a higher ability to define, focus, persist, guide, correct, redefine and, consequently, solve problems.

Thus, cognitive management skills are closely related to metacognition (Veenham, Van Hout-Wolters, & Afflerbach, 2006), which is one of the instruments that enables adequate performance, especially in learning and problem solving tasks.

Metacognition is a multidimensional construct that, according to the majority of current researchers, may include three basic elements: metacognitive knowledge, cognitive monitoring, and resolute strategy regulation. It is closely related to executive functions as a high-level cognitive process related to the control and regulation of cognitive functioning, when applied to the learning environment and problem resolution.

If giftedness (especially) and talent are the most complex intellectual profiles, it is logical to expect that gifted individuals are those who have a broader metacognitive repertoire to manage their high intellectual resources.

Despite metacognitive functioning differences found among preschoolers, school-children, and adolescents, results are not uniform (Munro, 2005; Steiner, 2006). Although gifted individuals seem to have a better declarative metacognitive knowledge and better skills to transfer strategies to dissimilar situations, they do not show consistency in the use of the correct strategy, in its transference, or in better resolution monitoring. Notwithstanding, they are better at using more advanced rules, at learning new strategies and using them more efficiently, and at solving problems; they also have greater flexibility to shift from one strategy to another in complex problems (Bartfurth, Ritchie, Irving, & Shore, 2009; Shore, 2000) and are better at transferring comprehension. In short, particularly gifted individuals know more about what they know, interconnect acquired knowledge, monitor and guide the resolutive process better, and use strategies in a more flexible manner.

Therefore, children with high abilities possess superior strategies for knowledge acquisition. They have more flexibility and a more appropriate use of strategies, but sometimes their strategic abilities seem similar to those of their peers. Possibly factors such as base knowledge, metacognition, or functioning variables such as perfectionism (Pyryrt, 2007; Chan, 2010; Rosner, in press) may be an influence in this regard. This reflects the need to intensify research for a better understanding of the phenomenon, particularly because its benefits may lead to broader flexibility and efficacy of their cognitive potential if used in effective education.

Within education initiatives, our group favors extracurricular enrichment, carrying out a program that is described below as one of the current initiatives in Spain.

b. UR-ARNAC extracurricular enrichment program

The UR-ARNAC extracurricular enrichment program is conducted at the University of La Rioja, with support from the Education Department of the Autonomous Government. It is aimed at boys and girls with high intellectual ability, either with a giftedness or talent profile, from 5 to 18 years old, in close relation with their regular school environment. The program operates weekly, on Saturday mornings.

The program is a differentiated research-based educative practice that is differentiated from regular school because it is based on how gifted and talented students learn. It offers different advanced and complex contents in all domains, uses articulation of thinking, and promotes higher-level thinking and creativity. It adds to, or goes beyond, the regular curriculum in a separate setting.

It is structured on the following objectives: (a) to boost/promote students' harmonic development as individuals and support crystallization of their high competency, (b) to promote cognitive development, (c) to increase the employment of thinking processes and cognitive management, (d) to facilitate the development of interpersonal skills between peers, (e) to avoid behavioral and/or learning dysfunctions, and

(f) to avoid motivational difficulties that arise from the dominance of curricular subjects.

These objectives, in turn, respond to the following principles: (a) appropriateness for intellectual profiles, competencies, interests, learning rhythm, and style of the high ability; (b) extends learning beyond the traditional curriculum; (c) complexity in proposing exposure to thinking systems, underlying principles, and theories; (d) interdisciplinarity, enabling the transfer of contents to various knowledge domains; (e) facilitating decision making; and (f) promoting creativity and problem resolution.

Based on the above, the program is structured in three intervention areas: (a) activation and management of cognitive resources through outlining and solving problems, (b) peer interaction and personal adjustment, and (c) personal and family coaching. These intervention areas, in turn, are applied to structured enrichment activities in connected workshops related to scientific–technological and humanistic ambits as well as those of creativity and interpersonal skills, that is, robotics, creativity, biotechnology, social mind, mythology and science, culture and human civilization, and so on.

Instructors are university graduates in psychology, education, or engineering with specific postgraduate training on high abilities according the National Association for Gifted Children's (NAGC) "Teacher knowledge and skill education standards for gifted and talented education" (VanTassel-Baska & Johnsen, 2007) and the recommendations of the International Panel of Experts for Gifted Education (2009). They have, at least, 3 years of experience in extracurricular enrichment practice.

It is thus intended to provide an effective enrichment environment that responds to the participants' characteristics by modifying its contents (ideas, concepts, information, facts), the process (promotes critical and creative thinking, adapts the presentation format of activities and contents), and the learning environment (psychological climate, physical space).

c. Evaluation of the enrichment program's effectiveness

It is indispensable to know the effectiveness of results obtained from participation in the program. Therefore, the following items are evaluated: (a) the participant's effectiveness at managing cognitive resources through repeated metacognitive measurements (*Metacognitive Awareness Inventory* [MAI] Inventory) and personal adjustment through Autobiography (Questionnaire Form U), and (b) participant and family satisfaction with program activities through the *Students' Satisfaction Questionnaire–CSA* and the *Parents' Satisfaction Questionnaire* (Sastre-Riba, Fonseca, & Santarén, in press), both constructed ad hoc, with an internal consistency of .86 and four subscales: Personal Satisfaction, Cognitive Management, Interpersonal Management, and Emotional Management.

An instrument is currently being developed to evaluate intervention effects on school behavior and motivation within standard educational contexts.

In view of the above, it can be inferred that research is vital to support our enrichment program and that such research must incorporate feedback from participants' results and responses. This will provide indicators for planning and for the adjustment of enrichment activities that are suitable to participants' profiles and characteristics. It

will also allow us to analyze and thereby return results on the participants' functioning in task resolution, cognitive management, and personal adjustment as well as to evaluate the overall effectiveness of the program. In short, there is need for research that will allow us to have better knowledge of the nature and functioning of high abilities, while evaluating the impact on them of an education intervention proposal, according to VanTassel-Baska, MacFarlane, and Feng (2008).

Given that prior empirical evidence shows that cognitive management skills are closely related to intellectual functioning (Sastre-Riba & Domènech, 2003), and with the aim to study the relationship that holds between metacognition and other intelligence measurements, this research team has studied temporal intrasubject stability in such competencies and its differential presence between diverse cognitive profiles of the program participants such as giftedness, quadruple talent, triple talent, double talent, and simple talent.

From among current research lines on profile extraction, measurement stability, problem resolution, interpersonal skills, excellence and perfectionism, and enrichment program evaluation and satisfaction, we include a description below of the part played, corresponding to this possible relationship between intellectual profiles and metacognitive management.

Method

Participants

The total number of participants in this study was $n = 49$ boys and girls between 12 and 16 years of age, all of whom had a profile of high intellectual ability and were voluntarily participating in the UR-ARNAC enrichment program from 2009 to 2011.

They represent a wide range of rural and urban locations and were identified as high-ability children as the result of the professional administration of standardized tests (intelligence, creativity, achievement, basically, and personality). They scored high on one or more intellectual aptitudes, and were asked to be part of the enrichment program.

The intellectual profiles of the participants were tested in the enrichment program through the use of formal measurement instruments for convergent (logical–deductive) and divergent (creativity) intellectual functioning. Given that the measurement stability of intellectual profiles at different points in time is taken into consideration, such stability was calculated by the z test and regression line, obtaining stability in all of them in the three measurement points (2009, 2010, and 2011), thereby confirming its consistency.

Their intellectual profiles were obtained following proposals by authors such as Renzulli (2005) and classified depending on the high scores on one or more intellectual aptitudes (Castelló & Batlle, 1998) as follows:

- Giftedness ($n = 16$),
- Simple talent ($n = 3$): all three with verbal talent,
- Complex talent ($n = 30$): includes double, triple, and quadruple talent.

Instruments

The following formal measurement instruments were used.

1. Multidimensional intellectual measure
 - a. Differential Aptitude Test (DAT; Bennett, Seashore, & Wesman, 2000), used to measure verbal, numerical, logical, and spatial reasoning.
 - b. Torrance's Creative Thinking Test (1974), benchmarked ad hoc for the Riojan sample.
2. Metacognitive measure

Cognitive management was assessed with the MAI (Schraw & Dennison, 1994; adapted by Domènech in 2004) because metacognitive knowledge and metacognitive regulation are measured through 58 items with a reliability of .95 on a Likert-type scale of 5 points. Some examples of these items are as follows (from Schraw & Dennison, 1994): *I do well organizing information* (metacognitive knowledge); *I think of various strategies to solve a problem before its resolution* (metacognitive regulation).

Procedure

The administration of these instruments was carried out annually at three points in time (2009, 2010, and 2011) in small groups of up to five participants, with a specially trained adult present.

Upon extracting the participants' intellectual profiles, we proceeded to (a) measure metacognitive functioning through the calculation of direct and final scores of the knowledge and metacognitive regulation dimensions for each participant; (b) calculate average metacognitive scores of knowledge and metacognitive regulation for each intellectual profile, matching them according to profiles using the nonparametric Mann–Whitney *U* test; (c) calculate Pearson's correlation between metacognitive dimensions for the different temporal measurement points; (d) calculate intrasubject stability measures via *z* scores and regression line analysis; and (e) carry out Wilcoxon's *W* test to calculate improvement in metacognitive effectiveness between temporal measures.

Results

Intellectual Profiles and Metacognitive Management

Table 1 shows the average metacognitive values for each type of intellectual profile.

As observed, although there are no significant differences in metacognitive functioning between the various high intellectual ability profiles, there is a trend showing that the higher the complexity of a profile (giftedness or quadruple talent vs. simple talent), the higher the metacognitive regulation. This result offers a suggestion that

Table 1. Average MAI Knowledge and Regulation Scores ($n = 49$).

	Giftedness ($n = 16$)	Complex talents ($n = 30$)			Simple talent ($n = 3$)
	<i>M</i> (<i>SD</i>)	Quadruple <i>M</i> (<i>SD</i>)	Triple <i>M</i> (<i>SD</i>)	Double <i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
MAI knowledge	4.65 (0.41)	4.20 (0.21)	4.15 (0.28)	3.95 (0.28)	3.80 (0.52)
MAI regulation	4.81 (0.63)	3.50 (0.67)	3.50 (0.64)	3.69 (0.19)	2.13 (0.15)

Note: MAI = Metacognitive Awareness Inventory. 1-2.5 = low score, 2.5-3.5 = medium score, 3.5-5.0 = high score.

metacognitive knowledge could be similar among profiles, but differences are centered on regulation, this is to say, on cognitive management. Possibly, the small sample size and small numbers of individuals in each profile make it difficult to find significance, if any.

Second, with the aim to examine metacognitive functioning through the various profiles obtained, depending on whether students belonged to the simple talent group ($n = 3$), complex talent group ($n = 30$), or giftedness group ($n = 16$), average scores of both MAI dimensions were compared. Data analysis carried out through the nonparametric Mann–Whitney U test showed that there were no statistical differences between groups ($p = .897$ for knowledge and $p = .135$ for regulation), when comparing the complex talent and giftedness groups; the reduced number of members in the simple talent group did not allow for this analysis to be carried out.

With regard to comparison with 2011 values, the nonparametric Mann–Whitney U test showed the existence of statistically significant differences ($p < .05$) between average regulation scores obtained by the triple-talent group ($M = 2.45$) and giftedness ($M = 3.25$), with the latter obtaining a higher average score. There were no statistically significant differences between average MAI scores obtained by other group pairs (double talent, quadruple talent).

These differences show that dissimilar profiles within high intellectual ability display differential metacognitive management in favor of the most complex profiles.

Stability to the Extent of Metacognitive Functioning and Effectiveness

With the aim of examining temporal stability between average scores obtained by participants in the two MAI dimensions (metacognitive knowledge and metacognitive regulation), Pearson's correlations were analyzed between temporal evaluation moments.

As illustrated in Table 2, results show the following:

- a. The correlation between the MAI regulation dimensions during the school years 2009-2011 and 2010-2011 was statistically significant reaching a value of $r = .716$, close to the value reached during 2009-2010 ($r = .717$);

Table 2. Pearson's Correlations for MAI Dimensions for 2009, 2010, and 2011.

MAI	2009 knowledge	2009 regulation	2010 knowledge	2010 regulation	2011 knowledge	2011 regulation
2009 knowledge	1					
2009 regulation	.720**	1				
2010 knowledge	.351	.232	1			
2010 regulation	.570**	.715**	.717**	1		
2011 knowledge	.254	.310	.445*	.332	1	
2011 regulation	.574*	.716**	.200	.660**	.392*	1

Note: MAI = Metacognitive Awareness Inventory.

* $p < .05$. ** $p < .01$.

- b. The correlation between the MAI knowledge dimensions during the school years 2009-2011 and 2010-2011 was not statistically significant, although it reached $r = .254$; and
- c. The correlation between the Self-knowledge dimension in the school year 2009-2010 and the regulation dimension in the school year 2010-2011 was moderate and statistically significant ($r = .574$).

Similarly, with the aim to examine whether there was an increase in the cognitive effectiveness improvement through time, the nonparametric Wilcoxon's W test was carried out. Data show that, although there was no statistically significant increase in average scores between evaluation times, there is an upward trend in scores obtained in the second temporal moment (school year 2010-2011), pointing to an improvement of these metacognitive abilities.

These results show not only the differences of metacognitive awareness related to different profiles among high intellectual abilities but also suggest the necessity to introduce and measure in the extracurricular enrichment program, concrete practices related to metacognition and problem solving strategies on both dimensions studied, which would provide a new perspective to better understanding high intellectual abilities and obtain optimal results.

Discussion

Given the poor conceptual clarity of the nature and functioning of high abilities and the necessary reflection about the effectiveness of education intervention initiatives in Spain, a proposal has been made regarding the importance of integrating research into an extracurricular enrichment program to enable a better knowledge of high-ability functioning in its diverse manifestations and the effectiveness of progressive psycho-educational activity.

Results show that the participants' different high intellectual ability profiles require differential metacognitive management in favor of more complex profiles.

Results also suggest that, although differences between the diverse temporal measurements taken over 3 years are not statistically significant, there is a trend toward an improvement in metacognitive effectiveness of the extracurricular enrichment program participants, especially in the metacognitive regulation dimension, which corroborates results obtained by other authors (Shore, 2000). This dimension is particularly relevant for the management of the intellectual resources of gifted (especially) and talented individuals and corroborates the idea that metacognition may be educated to optimize, first its own manifestation and then the expression of the high ability.

Because of their personal and social value, it is important to promote the expression of high intellectual abilities to help individuals achieve the excellence for which they are prepared. For this purpose, it is interesting to facilitate not only the good functioning of their constituting structural correlates but also the use of management tools for these cognitive resources.

There are some limitations to this study: (a) the lack of control regarding the changes on metacognition owing to the cognitive development of participants, to enrichment programs through immersion, or to other conditioning factors such as perfectionism; (b) the size of participant sample. It could prove interesting to study both in future research.

More specifically, it could be interesting to increase the size of the participants sample for each cognitive profile to further validate results through comparison with average intellectual ability children. It will be interesting to introduce metacognitive training activities in the extracurricular enrichment program specially related to metacognitive regulation and the measure of their probable impact on the metacognitive awareness of participants.

The results obtained may be valid not only to promote the expression of high abilities but also to optimize intellectual functioning in general, whatever its potentiality. On these grounds, parents and teachers may have another indicator to guide and promote a favorable environment that will foster excellence in conjunction with the neurobiological base and competences inherent to high intellectual ability.

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