Multidimensional Assessment of Giftedness: Criterion Validity of Battery of Intelligence and Creativity Measures in Predicting Arts and Academic Talents

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Título: Evaluación Multidimensional de la Superdotación: Criterios de validez de la Batería de Inteligencia y Creatividad para predecirlos talentos artísticos y académicos.
Resumen: Este trabajo tiene por objeto probar la utilidad de la Batería para la Evaluación de la Superdotación (BaSH/S, por sus siglas en portugués) para identificar diferentes grupos de alumnos superdotados en las aéreas de talento académico y artístico. La batería valora cuatro factores latentes: (a) inteligencia fluida, (b) producción de metáforas (creatividad verbal), (c) fluidez figurativa (creatividad figurativa), y (d) calidad del pensamiento divergente figurativo (creatividad figurativa). Se tomó una muestra de 987 alumnos adolescentes, 464 chicos y 523 chicas de edades de 8 a 17 años, que pertenecían a dos grupos: alumnos no superdotados (N=866) y alumnos superdotados (N= 67 habilidades académicas, N=34 habilidades artísticas y N=20 no identificados en un dominio especifico). El grupo de superdotados académicos presento las puntuaciones más altas en razonamiento y podían producir metáforas más originales y remotas, eran figurativamente más fluidos y sus dibujos eran más originales. Las habilidades académicas eran relativamente mayores en los superdotados académicos que en los artísticos (r = .39 vs r =.14). En el grupo de superdotados artísticos la fluidez figurativa y sus puntuaciones en originalidad eran relativamente más importantes que el razonamiento (r = .25 y r = .21 vs .14). El trabajo enfatiza la importancia de evaluar la creatividad en distintos dominios además de la inteligencia para mejorar el entendimiento de la superdotación y el talento.
Palabras clave: Superdotación, Talento, Creatividad, Inteligencia, Evaluación multidimensional, Producción de metáforas, Razonamiento fluido.

Abstract: We test the utility of the Battery for Giftedness Assessment (BaAH/S) in identifying differences in two groups of already known gifted students in the areas of academic and artistic talents. Four latent factors were assessed (a) fluid intelligence, (b) metaphor production (verbal creativity), (c) figural fluency (figural creativity), and (d) divergent thinking figural task quality (figural creativity). A sample of 987 children and adolescents, 464 boys and 523 girls, of ages ranging from 8 to 17 of two groups: regular students (N=866) and gifted students (N= 67 academic abilities, N=34 artistic abilities and N=20 no domain identified). Academic giftedness group of have higher reasoning, can produce more remote/original metaphors, high figural fluency and drawings rated as more original. Children in the group of artistic giftedness have higher reasoning, high figural fluency and drawings rated as more original. Reasoning abilities are relatively higher in academic giftedness group than artistic ($r = .39$ vs $r = .14$). Within artistic group figural fluency and ratings of originality are relatively more important than reasoning ($r = .25$ and $r = .21$ vs .14). We emphasizes the importance of assessing creativity in different domains in addition to intelligence to improve the understanding of giftedness and talent.
Key word: Giftedness, Talent, Creativity, Intelligence, Multidimensional assessment, Metaphor Production, Fluid Reasoning.

Introduction

Recent theories of giftedness adopt a multidimensional approach for defining it including intelligence and creativity, as well as other abilities like leadership characteristics, psychomotor ability, visual, performing and musical arts, and academic and non academic achievement areas (Heller, 2013). Although intelligence is considered the most widely used criterion for gifted identification, this does not mean that only intelligence merits attention from researchers and educators (Besjes-de Bock & Ruyter, 2011; Pfeiffer, 2015; Prieto, López-Martinez, & Ferrándiz, 2003). When intelligence tests are exclusive in screening of gifted students, gifted in other areas of exceptionality will be missed. Moreover it may be a risk of creating a homogeneous group with similar cognitive abilities (Pierson, Kilmer, Rothlisberg, & McIntosh, 2012). As consequence of gifted children identification based on intelligence tests, authors affirm that minority and impover-

ished students have been underrepresented in gifted and talented programs (Pfeiffer, 2015; Van Tassel-Baska, Feng, & Evans, 2007).

Recent orientation recommends the use of comprehensive assessment instruments in order to capture the broad spectrum of high ability (Calero & García-Martin, 2014; Hernández-Torrano, Férrandiz, Ferrando, Prieto & Férnandez, 2014). Diagnostic evaluation also usually requires protocols that exceed the classic IQ tests approach that include other components or characteristics associated with high capacities (Callahan, 2006; Montero-Linares, Navarro-Guzmán & Aguillar-Villagrán, 2013; Renzulli & Gaesser, 2015; Subotnik, Olszewski-Kubilius & Worrell). Due to this multidimensionality and complexity of giftedness and talent, researchers recommend a wide process of identification, based on all available information sources, using multiple criteria like standardized tests and informal instruments (teacher and parent checklists, questionnaires, school products and portfolios). A comprehensive process is considered the best practice for identifying gifted children (Baer & Kaufman, 2005; Renzulli & Gaesser, 2015; VanTassel-Baska, Feng, & Evans, 2007). The recognition of multiple perspectives and the use of a many sources of information can enlarge the giftedness assessment, reduce the number of false positives

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and negatives on identification process, and allow the identification of different types of talents. For instance, Sternberg (2010) exemplifies the difference between, in one hand; someone who is analytically gifted (but not gifted in other areas) may do well on standardized tests and activities that requires analytical reasoning. In another hand, someone creatively gifted may come up with many novel, different and original ideas but not necessarily will perform well on standardized tests since they tap more analytical skills than creativity. This fact justifies the importance of a comprehensive evaluation that considers the heterogeneity in the ways gifted talents manifests as well as cultural and linguistic specificities of the population (Almeida, Fleith, & Oliveira, 2013).

Nevertheless, literature review shows that most giftedness identification systems are based only on intelligence measures usually when a student receives a test score of two standard deviation above the mean, although cut-off scores are controversial since usually are determined in an arbitrary manner according to local needs as pointed by Lichtenberger, Volker, Kaufman and Kaufman (2006). Empirical studies shows that gifted sample are generally 1 to 1 1/3 standard deviation above control group test score mean, therefore being lower than expected according to the statistical criterion considered on giftedness identification. So, an important limitation of research in this area it´s the lack of consensus in giftedness conceptualization and identification (Dan, Swanson, & Cheng, 2011; Lichtenberger, Volker, Kaufman, & Kaufman, 2006; Roid, 2003; Volker & Phelps, 2004).

In order to contribute for a more comprehensive giftedness identification, we started to develop the Battery for Giftedness Assessment (*Bateria de Altas Habilidades e Sobredotação* - BaAH-S). BaAH-S has two parts, one with measures of intelligence and creativity and a second with teachers rating scale for screening a broad set of domains related to giftedness. BaAH-S assesses reasoning and creativity potential via performance tests, assessing other cognitive and socio-emotional skills like academic achievement, leadership and motivation via teachers report. We divided in two parts to avoid asking complicated abstract concepts to children. In BaAH-S problem solving is assumed isomorphic with fluid reasoning (Gf) defined as "the deliberate but flexible control of attention to solve novel "on the spot" problems that cannot be performed by relying exclusively on previously learned habits, schemas, and scripts" (Schneider & McGrew, 2012). According to Pierson, Kilmer, Rothlisberg and McIntosh (2012) the most test batteries include measures of fluid (gf) or crystalized intelligence (Gc), or a combination of both.

BaAH-S also assesses two different domains of giftedness: academic and productive-creative or artistic (Renzulli, 2004). Academic-related abilities are associated to high levels of school performance, logical and analytical thinking, good memory, great intellectual activity, and ability to processing complex information. These are standard potential attributes assessed in intelligence tests. Productive creative or artistic-related abilities are associated to curiosity, problem solving, creative thinking (such as fluency, flexibility and originality), production of ideas, innovations and artistic products. This second area is usually not well represented in standard intelligence tests used for gifted identification (Virgolim, 1997).

Creativity-related abilities has been emphasized as an important element in the most recent theories of giftedness: Differentiated Model of Giftedness and Talent by Gagné (2005), Three-Ring Conception by Renzulli (2005) and Wisdom, Intelligence and Creativity by Sternberg (2003). They believe that the inclusion of measures of creative potential into gifted programs will benefit students and will add valuable information about individual potential not currently assessed in intelligence tests (Kaufman, Plucker, & Russell, 2012). Dai, Swanson and Cheng (2012) completed a survey of empirical studies published in giftedness during 1998-2010 and state that creativity was one of the four most researched topics, amongst underachievement, socialemotional skills and alternative ways of identification. Authors point to the fact that intelligence assessment have been extensively tested and validated for the purpose of identification of giftedness while creativity assessment have more limited evidence on reliability and validity.

Any attempt to include creativity assessment for inclusion into gifted programs will face a complex and controversial topic of the lack of consensus about the construct definition and assessment (Beghetto, Plucker, & MaKinster, 2001; Cropley, 2000; Lemons, 2011). Many scholars have questioned if the divergent tests show predictive validity (Baer, 1994; Feist, 2004; Gardner, 1993; Han, 2003; Jarosewich et al., 2002; Kogan & Pankove, 1974; Schraw, 2005). But a lot of progress have been occurring recently such as new assessment methods (Silvia, Winterstein, Willse, et al., 2008), new methods of data analysis (Nakano & Primi, 2014; Primi, 2014; Silvia, 2007, 2011), predictive validity of creativity assessment tools (Kim, 2006; Plucker & Runco, 1998; Runco, Millar, Acar, & Cramond, 2011; Zeng, Proctor, & Salvendy, 2011), the structure and independence of evaluated traits (Chase, 1985; Clapham, 1998; Heausler & Thomson, 1988; Primi, Nakano, Morais, Almeida, & David, 2013; Runco & Mraz, 1992) and the validity of subjective rating (Benedek, Mühlmann, Jauk, & Neubauer, 2013; Chen, Kasof, Himsel, Greenberger, Dong, & Xue, 2002; Kaufman, Baer, Agars, & Loomis, 2010; Kaufman, Lee, Baer, & Lee, 2007; Silvia, 2011; Silvia, Martin, & Nusbaum, 2009; Silvia, Winterstein, Willse, et al., 2008). Also, in order the gifted children identification (children from 9 to 12 years old) an international research project is validating the Aurora Battery (Chart, Grigorenko, & Sternberg, 2008) in different countries, a specific battery considering three kinds of intelligences: analytical, synthetic (creative) and practical.

Some interesting critical reviews and reanalysis help to understand the issue of limited validity evidence of divergent thinking tests for assessing creativity. Plucker and Runco (1998) point to some limiting features of studies such as inadequate statistical procedures in presence of non-normal

distributions, short duration of studies and the inadequacy of outcome criteria in longitudinal studies - usually relatively centered in more on quantity than quality. Plucker (1999) re-analyzed the famous longitudinal studies of Torrance (1969, 1972,1987, 2002) and Torrance and Wu (1981) where they applied Torrance Tests of Creativity Thinking (TTCT) and followed 212 elementary school students for a long period of time and recorded creative achievements as outcome measures (Cramond, Matthews-Morgan, Bandalos, & Zuo, 2005; Runco, Millar, Acar, & Cramond, 2010). Plucker used structural equation modeling and showed strong evidence of predictive validity for verbal divergent thinking scores that had a stronger effect than intelligence in predicting creative achievement (this results were found for verbal but not for figural tests). The author points to the fact that outcome measures were biased to verbal domain and that could explain lack of validity of figural tests. Recent studies that used subjective scorings of quality of ideas produced in divergent thinking tasks - one of the old methods used by Guilford (Wilson, Guillford, & Christesen, 1953) - as opposed to quantity alone as measured by fluency scores, show that creativity is more strongly related to intelligence as previously though (Primi, 2015; Silvia, 2011, 2015).

These studies exemplifies that advances in assessment methods and statistical analysis have been showing the robustness of psychometric properties of creativity measures. Nevertheless there are few studies operationalizing measures incorporating these new advances in multidimensional batteries to assess and identify gifted students. Most studies undoubtedly still focus on intelligence only. The ones than combine intelligence and creativity are still scarce. Miller and Cohen (2012) suggest "that conceptions of giftedness and creativity encompass an extremely important aspect of human development: supporting and caring for others" (p.111). The Battery for Giftedness Assessment BaAH-S incorporated intelligence (fluid reasoning) and creativity measures in two domains - verbal and figural - aiming to sample responses from different domains of giftedness expressions. It also incorporates recent methods of subjective rating in addition to traditional measures obtained in divergent thinking tasks. The main goal of this paper is to test the utility of the BaAH-S in identifying children potential abilities. Therefore we intend to test criterion validity of BaAH-S in pinpointing differences in two groups of already known gifted students in the areas of academic and artistic talents. At the same time it aims to discuss the utility of a multidimensional assessment in the process of identifying domain-specific talents. We hope that BaAH-S can help to fill the gap related to the identification of a broad set of skills that are usually missed when using more narrow batteries not considering the multidimensional nature of giftedness and serve as an auxiliary tool for providing high quality services to this population

Method

Participants

The sample was composed of 987 children and adolescents, 464 boys and 523 girls, of ages ranging from 8 to 17 (the majority of the sample, 96%, were between 8 and 15 years old) $M = 11.58$, $SD = 1.89$. They were studying in 2 to 12 grade, most from 4-9 (96.6%). There were two main groups in this sample: one of regular students ($N = 866$), our control group, and a group of students identified as gifted students, our criterion group ($N = 120$). In the criterion group 67 students were identified in the domain of academic abilities ($M = 12.68$, $SD = 2.67$), 34 in the domain of artistic abilities ($M = 12.21$, $SD = 2.58$), and 20 students didn't have any specific domain identified at the time of data collection but had passed the tests on identification phase ($M = 12$, $SD = 1.49$).

Measures

The Battery for Giftedness Assessment (BaAH/S) is composed by four intelligence subtests (verbal, abstract, numerical and logical reasoning), two subtests of creativity (divergent thinking figural task and metaphors creation test) and a teacher rating scale. Only the objectives subtests were used in this study. The present study will add information about criterion validity of the battery, complementing previous studies about its internal factor structure (Ribeiro, Nakano, & Primi, 2014), item analysis using item response theory (Nakano et al., 2015; Nakano & Primi, 2014), the association between intelligence and creativity using confirmatory factor analysis (Nakano, Wechsler, Campos, & Millian, 2015).

The four reasoning subtests is a subset of items from the Battery of Reasoning Tests (BPR-5, Primi, & Almeida, 2000): *Verbal Reasoning (VR)*: 12 items of verbal analogies, with two pair of words. One of the pairs is incomplete. The subject has to choose, in five alternatives, the word that completes the second pair; *Abstract Reasoning (AR)*: 12 items of geometric analogies tasks, each one contend two pair of figures. One of them is incomplete. Using analogy, the individual have to select, among five options, the correct figure that complete the second pair; *Numerical Reasoning (RN)*: 12 numerical series, where the last two is incomplete. Considering the arithmetic relation between the numbers, the next two digits have to be discovered; and *Logical Reasoning (RL)*: 12 items that present practical and everyday situations as a context for logical premises. Student's needs to use deductive reasoning to relate premises and make conclusions that are asked. The number of correct conclusions is different in each problem, varying between 1 and 4.

The divergent thinking figural task (DTF) is a subtest of the Test of Creativity in Children's Drawings (Nakano, Wechsler, & Primi, 2011). It consists of 10 incompletes stimulus that have to be completed with creating drawings.

Eleven creative characteristics are analyzed, grouped into three factors (Ribeiro, Nakano, & Primi, 2012): *Elaboration* (FG_ELB): scores five attributes of drawings - fantasy, uncommon perspective, internal perspective, context use and elaboration; *Emotion* (FG_EMO): scores three attributes of drawings - emotion expression, movement and expressiveness of titles; and *Cognitive* (FG_COG): scores three traditional factors - fluency, flexibility and originality. The ten drawings were also scored by raters in a 5-point scale (from not original/creative to very creative/original). This measures composed a score on divergent thinking figural task quality (DTFq).

Metaphor Creation Test (MCT, Primi, 2014). MCT is a new method for the assessment of creativity using the divergent production of metaphors in tasks such as "*The **camel** is ------- of the **desert**"* or "*The **grass** is the _____ of the **land**"*. The test is composed of five items asking for a maximum of four responses to each item. Subjects were instructed to fill in the blank space with a creative metaphor and explain each of their responses. Raters scored each response for quality and flexibility. Quality (quat_tri) was defined using a four-point rating scale (0 not a metaphor to 3 high original and remote association). Flexibility (flx) was scored for each item on a four-point scale ranging from 1 to 4 depending on the number of shifts in response categories. Raters were trained in two sessions to masters the scoring criteria. The subjects´ scores were calculated from the Many Facet Rasch Measurement (MFRM) that estimates latent scores of quality of metaphors. Flexibility scores were calculated as an average shifts in categories.

Procedure

We recruited general group of regular students (control group) from public and regular elementary schools conveniently located in four Brazilian cities. Criterion group are students from a city program to the Student with High Skills/Giftedness run by the Secretary of Education at Brasilia Federal District. They were previously identified by the program selection procedures. The program divides students into seven subgroups. Each one attends to thematic classes of arts (two classes), academic (three classes) and mixed (two classes).

The identification process starts with referral from teachers, professionals from school community, and family, fellow student or by self-assessment. Once joining the program, students will undergo an observation phase – that may last from four to sixteen weeks – where program professionals will observe and assess student capabilities with intelligence tests - WISC-III, Raven's Progressive Matrices, Battery for Reasoning Tests (BPR-5) - interest survey questionnaires, creativity exercises and general records containing information and student productions.

In the next stage those students who reach the profile defined by the program, will be transferred to the intervention phase that offers enrichment activities and support to

the students and their families (type I, II and III as proposed by Renzulli, 2004). Assessment results will identify students as gifted in academic or artistic area and refer to stimulation and enrichment groups in accord with their skills and interests. Program activities usually ends on the last high school year.

On of the researchers administered the tests during the enrichment classes of academic and arts. Tests were collectively administered in a single occasion in the classroom lasting an average of 90 minutes. Students responded initially to four subtests of reasoning followed by the figural creativity activity and finally the divergent production of metaphors. The objectives of this study and the assessment instruments have been presented to parents and students in order to obtain their informed consent to participate in this research.

Data Analyses

Data analysis focused on examining the relationship of criterion variables and latent factors derived from BaAH-S. There were two criterion variables (observed variables): CR_ACD and CR_ART that were dummy variables (1 if in criterion group and 0 otherwise) representing if student were identified as having academic talents and artistic talents respectively. Validity studies tests weather: "a theoretical attribute has a causal effect on test scores…but since many attributes cannot be manipulated…validation of tests for these attributes is therefore restricted to correlational studies…that compare tests scores of groups of persons that are assumed to differ in the attributes" (Borsboom & Mellenbergh, 2007, p. 101). So our criterion subsamples were identified using multiple methods and source of information as possessing high level of potential abilities related to academic and artistic domain. Therefore we hypothesize that if constructs measured in BaAH-S are valid - that is, they capture potential attributes in intelligence and creativity that are key constructs that characterize this subsample - they should be associated with these criterion variables. Additionally, since BaAH-S is a multidimensional battery measuring creativity (verbal and figural) and intelligence we intend to explore if its factors have different relationships with these two criterions. This will contribute to understand if different factors are associated more strongly with different domain of talent.

We approach this analysis with a multiple-indicator, multiple-causes (MIMIC) model (MacIntosh & Hashim, 2003). The measurement model (Figure 1) is composed of four latent factors: (a) fluid intelligence (Battery of Reasoning Test – BRT) reflected in four indicators (logical reasoning RL, numerical reasoning RN, abstract reasoning RA, and verbal reasoning RV), (b) metaphor creation test reflected by two indicators (MCT, quality of metaphors and flexibility), (c) divergent thinking figural task reflected in three indicators (DTF, elaboration, emotional features and cognitive variables), and finally (d) divergent thinking figural task quality (DTFQ) reflected by five observed variables (subjective rat-

ing of originality of the five first drawings in a scale of 1 no original to 5 very creative/original).
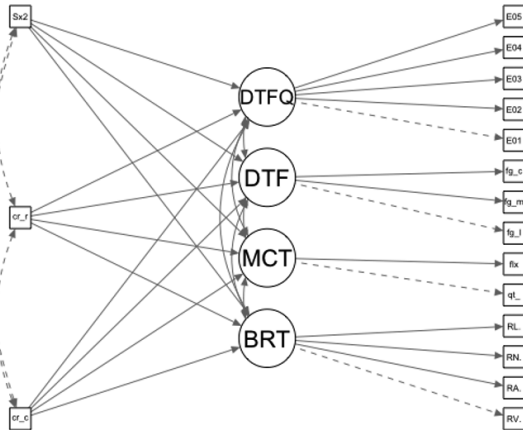
Figure 1. Model representation of multiple-indicator, multiple-causes (MIMIC) for testing the relationship of criterion variables (dummy group variables indicating domain of giftedness - academic and artistic) on latent variables of BaAH-S (fluid intelligence - BRT, divergent thinking figural task - DTF, divergent thinking figural task quality - DTFq and metaphor creation test - MCT).

These four latent factors are regressed on two observed indicators as well as gender dummy variable (1 for girls and 0 for men) as a control variable. These variables are represented in the left part of Figure 1. A confirmatory factor analysis with covariates (MIMIC) was estimated by the

MPLUS using MLR algorithm of estimation (maximum likelihood) that produce parameter estimates with standard errors and a chi-square test statistic that are robust to non-normality of observed variables. It also can model variables with non-standard normal distributions like count and ordered categorical like in likert-item types (Muthén & Muthén, 2010). Our main hypothesis is tested with the size and significance of criterion variables associations on latent factors of BaAH-S. In addition of MPLUS we used R-packages, *Psych*, *semPLOT*, *lavann*, and open software JASP for general statistical analysis and figures (Epskamp, 2015; Love et al., 2015; Revelle, 2015; Rosseel, 2012).

Results

Table 1 presents descriptive statistics of the variables and subtests of BaAH-S for the entire sample. In general most variables show distributions close to normal (RV, RA, RN, RL, qual_tri, fg_cog). Two variables from figural fluency task show a moderate positive asymmetry and kurtosis since they have a substantial number of zero counts. Also the scores produced by the subjective ratings of drawings produced in figural fluency (E01, E02, E03, E04 and E05) are slightly positively skewed. When running the SEM analysis we tried to accommodate these departure from normal distributions modeling fg_elb and fg_emo as a count variable and E01-E05 as ordered categorical.

Table 1. Descriptive Statistics of the Variables and Subtests of BaAH-S.

Domain / indicators	*n*	*Mean*	*SD*	Min	Max	Skew	Kurtosis
Battery of Reasoning Test - Gf: Reasoning							
RV.tot	987	5.91	2.12	0.00	12.00	0.17	0.15
RA.tot	987	6.50	2.56	0.00	12.00	-0.12	-0.35
RN.tot	987	5.34	3.21	0.00	12.00	0.27	-0.97
RL.tot	987	4.86	3.11	0.00	12.00	0.04	-0.91
Divergent Thinking Figural Task (DTF)							
fg_elb	961	18.39	14.07	0.00	94.00	1.07	1.72
fg_emo	959	3.67	3.66	0.00	20.00	1.04	0.78
fg_cog	961	17.39	7.18	0.00	45.00	-0.42	-0.44
Metaphor Creation Test (MCT) Verbal							
quat_tri	906	-2.39	1.70	-7.02	1.84	-0.45	-0.36
flx	906	0.64	0.45	0.00	2.50	0.61	0.59
Divergent Thinking Figural Task Quality (DTFq)							
E01	875	2.12	1.16	0.00	5.00	0.57	-0.17
E02	906	2.14	1.12	0.00	5.00	0.55	-0.21
E03	853	1.96	1.08	0.00	5.00	0.45	-0.15
E04	829	1.68	1.00	0.00	5.00	0.76	0.43
E05	788	2.09	1.16	0.00	5.00	0.13	-0.30

Legend: RV.tot = verbal reasoning; RA.tot = abstract reasoning; RN.tot = numeric reasoning; RL.tot = logical reasoning; fg_elb = figural elaboration factor; fg_emo = figural emotional factor; fg_cog = figural cognitive factor; quat_tri = quality of metaphors by IRT; Flx= metaphor flexibility; E01 to E05 = rated quality of figural stimulus 1 to 5.

Table 2 shows standardized parameter estimates and inferential statistics for the MIMIC model described in Figure 1. It presents the parameter estimate (Par est), its standard error (se) their ratio (Par/se). A first run specified indicators variables as continuous. The last two columns show the parameters estimates and *se* for the same model but consider-

ing the variables fg_elb and fg_emo as a count variables and E01-E05 as ordered categorical variables. As can be seen there is no marked differences in the parameters coming from the two runs.

The model converged to an identifiable solution. Fit indices of the model were adequate: $\chi^2 = 450.1$, df = 101,

χ^2/df = 4.4, RMSEA = .059, CFI = .93, TLI=.91, SMR =. 04. Values of measurement parameters indicate that all indicators had high loadings in their correspondent latent factor. The bottom part of the Table 1 shows the latent construct correlations. It shows that variables of figural fluency and subjective rating of quality is highly associated (r = .88); it shows also that divergent production of metaphor has a high relationship with fluid reasoning factor (r =.60). All other latent factors had small to moderate associations (.20 to .30).

Gender was entered as a control variable so as to disentangle associations of criterion variables with latent constructs that could eventually be due to unbalanced gender distributions across groups. We observed gender differences only in quality of drawings in figural fluency tasks. Girls tend to do slightly well than boys. It was observed that criterion groups tended to have relatively less girls than boys and this relationship is stronger in the academic giftedness group.

Table 2. Standardized Parameter Estimates, Standard Errors, Ratio and Level of Significance for the MIMIC Model Described in Figure 1.

Variables	Par est	se	Par/se	sig	Par est2	se
Measurement model						
Battery of Reasoning Test - Gf: Reasoning						
RV_TOT	0.75	0.02	41.89	0.000	0.75	0.02
RA_TOT	0.77	0.02	45.14	0.000	0.77	0.02
RN_TOT	0.73	0.02	39.62	0.000	0.73	0.02
RL_TOT	0.70	0.02	35.40	0.000	0.70	0.02
Metaphor Creation Test (MCT) - Divergent Verbal production						
QUAT_TRI	0.98	0.02	48.59	0.000	0.98	0.02
FLX	0.81	0.02	39.67	0.000	0.81	0.02
Divergent Thinking Figural Task (DTF)						
FG_ELB	0.94	0.02	48.46	0.000	0.59	0.05
FG_EMO	0.40	0.03	12.97	0.000	1.00	0.00
FG_COG	0.47	0.03	16.95	0.000	0.60	0.03
Divergent Thinking Figural Task Quality (DTFq)						
E01	0.69	0.02	31.82	0.000	0.73	0.03
E02	0.71	0.02	34.05	0.000	0.78	0.03
E03	0.61	0.03	24.11	0.000	0.68	0.03
E04	0.54	0.03	19.17	0.000	0.59	0.04
E05	0.55	0.03	19.46	0.000	0.57	0.04
Criterion validity coeficients						
Academic giftedness						
CR_ACD --> GF	0.39	0.03	12.87	0.000	0.39	0.04
CR_ACD --> V_METAPH	0.14	0.03	4.25	0.000	0.14	0.03
CR_ACD ---> PIC	0.22	0.03	6.88	0.000	0.13	0.03
CR_ACD ---> PIC QUAL	0.11	0.04	3.19	0.001	0.10	0.04
Artistical giftedness						
CR_ART --> GF	0.14	0.03	4.27	0.000	0.14	0.04
CR_ART --> V_METAPH	0.02	0.03	0.61	0.540	0.02	0.04
CR_ART ---> PIC	0.25	0.03	7.71	0.000	0.12	0.03
CR_ART ---> PIC QUAL	0.21	0.04	5.70	0.000	0.20	0.04
Control variable						
Gender						
SEXO2 --> GF	0.02	0.03	0.51	0.608	0.02	0.03
SEXO2 --> V_METAPH	0.04	0.03	1.31	0.190	0.04	0.03
SEXO2 ---> PIC	0.05	0.03	1.37	0.172	0.15	0.04
SEXO2 ---> PIC QUAL	0.09	0.04	2.32	0.020	0.07	0.04
Factor correlations						
GF vs V METAPH	0.60	0.03	20.48	0.000	0.60	0.03
GF vs PIC	0.27	0.04	7.36	0.000	0.29	0.04
V METAPH vs PIC	0.23	0.04	6.61	0.000	0.22	0.04
GF vs PIC QUAL	0.34	0.04	8.69	0.000	0.32	0.04
V METAPH vs PIC QUAL	0.27	0.04	7.23	0.000	0.26	0.04
PIC vs PIC QUAL	0.88	0.03	34.80	0.000	0.62	0.06
CR_ART vs CR_ACD	-0.03	0.03	-0.91	0.364	-0.03	0.02
SEXO2 vs CR_ACD	-0.15	0.03	-4.80	0.000	-0.15	0.03
SEXO2 vs CR_ART	-0.08	0.03	-2.47	0.014	-0.08	0.03

Legend: RV.tot = verbal reasoning; RA.tot = abstract reasoning; RN.tot = numeric reasoning; RL.tot = logical reasoning; fg_elb = figural elaboration factor; fg_emo = figural emotional factor; fg_cog = figural cognitive factor; quat_tri = quality of metaphors by IRT; Flx= metaphor; flexibility; E01 to E05 = rated quality of figural stimulus 1 to 5; CR_ACD = academic gifted; CR_ART = artistic gifted; GF = fluid intelligence; V_METAPH = metaphor production; PIC = figural creativity; PIC QUAL = figural quality; SEXO 2 = gender.

Criterion validity information is presented in the middle part of Table 2. All latent variables shows significant correlations with criterion ranging from small to moderate (*r*=.11 to *r*= .39). Children in the group of academic giftedness have higher reasoning, can produce more remote/original metaphors, high figural fluency and drawings rated as more original. Children in the group of artistic giftedness have higher reasoning, as well as high figural fluency and drawings rated as more original. Moreover reasoning abilities are relatively higher in academic giftedness group than artistic (*r* = .39 vs *r* =.14). Within artistic group figural fluency and ratings of originality are relatively more important than reasoning (*r* = .25 and *r* = .21 vs .14).
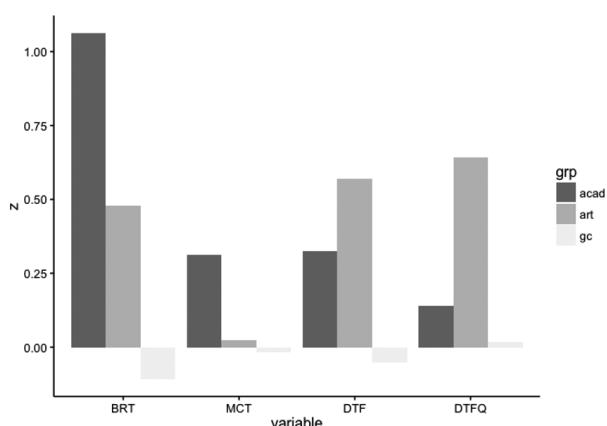
Figure 2. Mean of scores of control group, criterion groups (art and academic) on the four factors of BaAH/S (standardized scale per factor – M = 0, DP = 1).

Figure 2 shows this interaction of creativity/intelligence with area of giftedness. Before preparing this figure all variables were standardized in a z score (*M* = 0, *SD* = 1). Figure shows average scores on four scores fluid intelligence (BRT), metaphor creation test (MCT), divergent thinking figural task (DTF) and divergent thinking figural task quality (DTFq) on the three groups (gray scale) control, art and academic. It is clear that academic group is higher in fluid reasoning and metaphor production while artistic group have higher scores on figural fluency tests quality.

Discussion

This paper reports criterion validity of a battery assessing intelligence and creativity for giftedness assessment. The main goal was to test the utility of the BaAH/S in identifying students with high abilities. We found positive associations with criterion in all measures of intelligence and figural and verbal creativity measures. As expected, intelligence (fluid reasoning) predicts both types of giftedness with a significant association, but results show that creativity is also associated to giftedness. It provides evidence that adding different abilities in the assessment process can improve the accuracy of the giftedness identification (Calero & García-Martín, 2014; Gal-

lagher, 2008, Hernández-Torrano, Férrandiz, Ferrando, Prieto, & Férnandez, 2014; Renzulli & Gaesser, 2015). Literature recognizes the multidimensional nature of giftedness (Feldman, 2000; Heller, 2013; Li et al., 2009; Kaufman & Sternberg, 2008; Jarosewich, Pfeiffer, & Morris, 2002; Robinson & Clinkenbeard, 2008) although it is not common to find evidence of criterion validity of comprehensive measures in gifted samples (Bracken & Brown, 2006, Baer & Kaufman, 2005; Kaufman, Plucker, & Russell, 2012; Kerr & Sodano, 2003, Hazin et al., 2009, Sternberg, 2010). So, BaAH/S validity results assure that the addition of creativity in different domains can provide complementary information in identifying talents.

A second objective was to explore if assessing different domains adds additional information in predicting areas of giftedness. Results showed, as expected, that academic gifted students presented higher scores in intelligence measures, in all types of reasoning evaluated (verbal, abstract, logical and numeric) as well as metaphor production. Also artistic had higher scores in figural divergent thinking tasks. We could observe an interaction between the creativity domains by type of giftedness. This result emphasizes the value of assessing multiple attributes in understanding gifted individuals (Renzulli, 2004; Sternberg, 1981). It also shows the importance of divergent thinking measures in figural domain. Pluker (1999) discuss that the lack validity of figural tests may be related to the nature of criterion measures that overly sample characteristics of verbal-academic domain. In this study there is a close approximation of the outcome measure (arts) and the abilities assessed in figural tests. This may have facilitated to find associations between the two.

An unexpected finding is that artistic group didn't show higher scores in metaphor task but academic group showed better performance in this task. Metaphors task is defined as "an instrument for evaluation of cognitive components of creativity" (Primi, Miguel, Couto, & Muniz, 2007, p.198). Recent studies shows a stronger role of intelligence in creative thinking than previously thought especially implicating executive functions, working memory and fluid intelligence in the production of creative metaphors (Benedeck et al., 2013; Chiappe & Chiappe, 2007; Kazmerski, Blasko, & Dessalegn, 2003; Primi, 2014; Silvia & Beaty, 2012). For example, Beaty and Silvia shows that crystallized knowledge could only predict individuals' ability to generate conventional metaphors (*r* = .30), but fluid intelligence predicts creative metaphor production (*r* = .45) and is not associated with conventional metaphors production. We replicated this finding observing a strong association of divergent production of metaphors with fluid reasoning (*r* =.60, similar to what was found in Primi, 2014). David, Morais, Primi and Miguel (2014) found that scores on Metaphor Creation Test has a strong association with grades in high school Portuguese students. Therefore metaphor-intelligence associations may reflect common mechanism of fluid reasoning and production of creative and abstract metaphors that are higher in academic gifted samples but not so in artistic talent.

In conclusion, multidimensional assessment instruments like BaAH/S can be useful detecting different profiles that identify domain specific talents. Its use implies changes in identification process considering a brother set of attributes including potential related creativity in arts in addition to already important aspect related to academic abilities.

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