Addressing the 'quiet crisis': Gifted identification with Aurora

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One of the key issues in the field of gifted education is the identification of children with high abilities, as identification is the first step in giving these students the opportunities they need to develop their potential. The Aurora Battery, based on Sternberg's Theory of Successful Intelligence, is an assessment designed to identify children with high ability in areas that are typically ignored with the instruments that are currently used in gifted identification. In this study we examine Aurora's convergent and divergent validity using the TerraNova, a conventional assessment of academic achievement. We then explore the overlap of these assessments with regard to whom they identify as gifted. Results suggest Aurora's sound psychometric properties and ability to discriminate a more encompassing form of giftedness. We finally discuss the premise and implications of the Aurora Battery for gifted identification and education.
Keywords: *Gifted identification; successful intelligence; multi-dimensional assessment; psychometric evaluation.*

GIFTED CHILDREN are a nation's most precious natural resource as they represent the nation's future (Sternberg, 1996b). One of the most important issues in the field of gifted education is the identification of gifted students. The challenge of formally identifying unique intellectual profiles can be traced back nearly a century ago to what led to the development of standardised tests of intelligence. While this may sound like a mere historical anecdote, it is sobering that a survey of the literature reveals that most of the tools being used today to identify gifted children are revisions of, or largely based upon, theoretical frameworks and instruments constructed a century ago (Mandelman, Tan, Aljughaiman et al., 2010).

While the theoretical frameworks upon which these traditional measures are built may still be sound, instruments based on them continue to exclude individuals who possess gifts worthy of attention and nurturing due to the narrow scope of these instruments. The exclusion of those who have gifts in areas outside of the narrow scope of traditional assessments have been, and continue to be, one of the greatest objections to gifted education, an issue that has been referred to by the US Government as a 'quiet crisis' (US Department of Education, 1993). The US Government in the Jacob K. Javits Gifted and Talented Education Act (US Department of Education, 1993) explicitly states, when defining gifted and talented, that 'Outstanding talents are present in children and youth from all cultural groups, across all economic strata, and in all areas of human endeavour' (p.26). The identification methods that are being used most widely today, *g*-based assessments, capitalise on a single, unitary construct of 'general intelligence' (Mandelman, Tan, Aljughaiman et al., 2010), are not in line with this definition and continue to exclude many individuals with diverse abilities and backgrounds (Ford & Trotman, 2000).

Since Charles E. Spearman (1927) proposed his *g*-based theory of intelligence, there have been many attempts to better define and classify human intelligence. Particularly since the 1980s, there has been great interest in alternative, more encompassing models of human intelligence and abilities (for a comprehensive review of these theories see Sternberg, Jarvin & Grigorenko, 2010). One such model is Robert J. Sternberg's Triarchic Theory of Intelligence, also known as the Theory of Successful Intelligence (1985, 1988, 1996a, 1999, 2005). Successful intelligence is defined as the integrated set of abilities needed to attain success in life, however, an individual defines it, within his or her sociocultural context. Successfully intelligent people adapt to, shape, and select environments through a balance in their use of analytical, creative and practical abilities. According to this view, intelligence and success are defined beyond what happens in school to the broader context of what happens in life. Therefore, early recognition of and teaching to these component abilities of intelligence can set children on a road to success that will last well beyond their time in school.

The three abilities highlighted in the Theory of Successful Intelligence (1985, 1988, 1996a, 1999, 2005) are analytical, practical and creative abilities. Analytical abilities are involved in analysing, evaluating, judging, and comparing and contrasting. These abilities are exhibited in reasoning and logical thinking as they are exercised in activities such as debating, research, and mathematical problem-solving. Creative abilities are reflected in the capacity to generate new ideas, create and design new things. Such abilities are particularly well assessed by problems highlighting how well an individual copes with relative novelty. Practical abilities are involved when individuals apply or adapt their abilities to the kinds of problems that confront them in daily life, such as on the job or in the home. These abilities are also exercised in leadership and other social interactions. A successfully intelligent person does not necessarily have to possess high levels of each of these abilities to be considered intelligent; rather one must recognise one's own strengths and weaknesses and develop compensatory strategies that rely on those strengths.

The importance of a better understanding of student cognitive abilities cannot be overstated (Chart, Grigorenko & Sternberg, 2008). As it stands now, student evaluation is largely based on academic achievement (as indicated either by class grades or by standardised test scores) and teacher assessment. Both, though useful and valuable, are actually quite limited in perspective. Indeed, these limitations lead to unrecognised and un-nurtured abilities, and for at least some students, may have devastating long-term effects. There is a great need for new ways and tools to assess student abilities beyond traditional IQ tests and standardised achievement tests. To address these issues, The Aurora Battery, a multi-tool, multi-informant battery (Chart et al., 2008) is being developed based on the Theory of Successful Intelligence (Sternberg, 1999, 2005). Its purpose is not only to provide a much needed broader perspective of student abilities, but also to highlight areas of ability that are not currently being nurtured in school but are necessary for individuals' long-term success.

Description of the Aurora Battery

The essence of the Aurora Battery is to provide a multifaceted view of a child's intellectual profile, as expressed through a range of abilities (Chart et al., 2008). It is designed to meet the needs of parents who are interested in better understanding their child's intellectual profile, and teachers, counselors, or schools attempting to identify individual differences among their student body.

The Aurora Battery is composed of multiple modules that involve multiple informants, including a group administered maximal performance assessment (Aurora-*a* and -*g*; for Aurora-*a*, -*g*, -*i*, and -*r*, see Chart et al., 2008), a parent rating scale or alternatively available as a semi-structured interview (Aurora-*i*), a teacher rating scale (Aurora-*r*), and a self-report rating scale (Aurora-*s*; Mandelman, Tan, Kornilov et al., 2010). The Aurora Battery measures abilities as exemplified by analytical, creative and practical thinking in dealing with words, numbers, and objects. Each module of the battery is structured on the grid of abilities and domains depicted in Table 1. Thus, each is composed, in a balanced matter, of items comprising subtests that examine an ability –

Table 1: The Aurora Battery structure.

	Analytical	Creative	Practical
Images (Figural)	Floating Boats: identify matching patterns among connected boats. (5 items) (MC)	Book Covers: interpret an abstract picture and invent a story to accompany it. (5 items) (OE) Multiple Uses: devise three new uses for each of several household items. (5 items) (OE)	Paper Cutting: identify the proper unfolded version of a cut piece of paper. (10 items) (MC) Toy Shadows: identify the shadow that will be cast by a toy in a specific orientation. (8 items) (MC)
Words	Words That Sound the Same (Homophone Blanks): complete a sentence with two missing words using homonyms. (20 items) (RW) (Limited) Metaphors: explain how two somewhat unrelated things are alike. (10 items) (OE)	(Inanimate) Conversations: create dialogues between objects that cannot typically talk. (10 items) (OE) Interesting (Figurative) Language: interpret what sentence logically comes next after one containing figurative language. (12 items) (MC)	(Silly) Headlines: identify and explain an alternative 'silly' meaning of actual headlines. (11 items) (RW) Decisions: list elements given in a scenario on either 'good' or 'bad' side of a list in order to make a decision. (3 items) (RW)
Numbers	Number Cards (Letter Math): find the single-digit number that letters represent in equations. (5 items) (RW) Story Problems (Algebra): (before any algebra training) devise ways to solve logical math problems with two or more missing variables. (5 items) (RW)	Number Talk: imagine reasons for various described social interactions between numbers. (7 items) (OE)	Maps (Logistics Mapping): trace the best carpooling routes to take between friends' houses and destinations. (10 items) (RW) Money (Exchange): divide complicated 'bills' appropriately between friends. (5 items) (RW)

Note: MC: Multiple Choice; OE: Open-ended items that need to be scored by an individual using a rating scale; RW: Answers are either Right or Wrong.

analytical, creative, or practical – in one of three domains, verbal, numerical, or figural.

Aurora-*a* is composed of 16 subtests that are designed to assess a child's, analytical, creative, and practical abilities. There are five subtests for the assessment of analytical ability; five for the assessment of creative ability; and six for the assessment of practical ability. The subtests present multiple formats – multiple choice (four subtests), short answer (scored right or wrong; seven subtests), and open-ended response questions (five subtests). As reflected in Table 1, each subtest contributes to an ability score (Analytical, Creative or Practical) and to a domain score (Images, Words or Numbers). Aurora-*a* has been found to be psychometrically sound (Kornilov et al., 2012) with internal consistency coefficients in the acceptable range (mean Cronbach's alpha=.70), as well as good criterion validity with two standardised/normed instruments used in the British educational system.

Aurora-*i* for parents, Aurora-*r* for teachers (Chart et al., 2008), and Aurora-*s* for self-reports (Mandelman et al., 2010) are parallel rating scales that are filled out by parents, teachers and students, correspondingly. These scales cover analytical, practical, and creative abilities as well as a memory component. There are a total of 40 questions divided evenly between them. The scales were carefully designed in parallel, such that the exact same latent construct is evaluated by student, teacher and parent by items that are phrased as similarly as possible. The use of multiple informants in the identification process has been suggested to help overcome the under-identification of diverse groups of gifted students (Ford & Trotman, 2000; VanTassel-Baska, Feng & De Brux, 2007).

Implication for gifted identification and education

Aurora's aim is to effectively broaden the scope of gifted identification in the school setting by assessing important cognitive abilities, namely creative and practical, that have been overlooked in the past, as well as analytical ability, that has dominated conventional approaches to gifted identification. By broadening the scope of identification, students who would previously have gone unidentified despite their significant abilities, may be identified and the appropriate educational accommodations made to ensure that their potential is nurtured. Aurora's ability to identify cognitive strengths and weaknesses can in turn be used as a guide for adjusting the delivery and assessment of curriculum materials, and for addressing areas of thinking that need practice and development (Sternberg & Grigorenko, 2004). A secondary but no less important purpose of Aurora is to challenge the status quo and bring to the forefront of the field of education the importance of abilities that are not traditionally recognised in the school setting but that surely play a role in academic performance and success both in school and beyond (Sternberg, 2010).

The Aurora Battery is unique in the theory it employs, its design, format and administration. It can fill a substantial gap that exists in school practice by providing information on a child's cognitive ability that is accessible to and usable by educators in the classroom that can lead to the identification of students who would have not been identified with the current identification tools. While Aurora has great promise, more research is needed to further establish its validity.

In the current study we examined Aurora's convergent and divergent validity using the TerraNova – a conventional assessment of academic achievement (CTB/McGraw-Hill, 2010a, 2010b) to explore the overlap of these instruments with regard to whom they identify as gifted. Data analyses were conducted to estimate Aurora's criterion validity (against the TerraNova) as well as the sensitivity and specificity of Aurora's gifted identification, in comparison to TerraNova's gifted identification. We expected a weak to moderate overlap in the students that were identified using the respective measures, given the theoretical differences underlying these instruments and the constructs they are designed to measure.

Method

Participants

The participants who took Aurora (*N*=145, 69 female, 76 male, *M*=10.29, *SD*=1.0) in this study were 4th, 5th and 6th graders attending a suburban Midwestern US private parochial school (4th graders, *N*=50, 29M/21F, age *M*=9.20, *SD*=.40; 5th graders, *N*=48, 23M/25F, age *M*=10.35, *SD*=.48, 6th graders, *N*=47, 24M/25F, age *M*=11.38, *SD*=.49). Parental consent along with student assent from all of the participants were collected in accordance with the Human Subjects Committee protocol of Yale University. The Aurora testing took place over two days in a large group setting.

Instruments

The Aurora Battery (Chart et al., 2008), was used to assess students' cognitive abilities (analytical, creative, and practical) across three domains (verbal, numerical, and figural). Preliminary analyses with this sample indicated good internal consistency of the test scores, with a median Cronbach's alpha=.79. Other psychometric properties of the Aurora Battery have been shown to be satisfactory (Kornilov et al., 2012).

The TerraNova (CTB/McGraw-Hill, 2010a), a widely used standardised norm-referenced group achievement test, was employed to evaluate student achievement in the areas of reading, language, mathematics, science, and social studies. The TerraNova produces six scaled scores, one in each of the areas covered. By design, the TerraNova also yields a total composite score that is based on the reading, language and mathematics scores, to reflect a child's overall performance. In this sample, the composite score appeared to be reliable (Cronbach's alpha=.85) and was used in this study as the main external criterion for gifted identification. Extensive research with the TerraNova supports its excellent reliability, and provides strong evidence for its validity (CTB/McGraw-Hill, 2010b) and utility as a gifted identification tool (e.g. Neumeister et al., 2007; Pierce et al., 2006).

Procedure

Aurora-*a* was administered over two consecutive days; each day consisted of two 45-minute testing periods separated by a 15-minute break. The TerraNova was administered in a separate group session with delays ranging from 31 to 336 days (mean delay=243.8) due to field/organisational constraints. Data analyses were conducted to estimate Aurora's criterion validity (against the TerraNova) as well as the sensitivity and specificity of Aurora's gifted identification, in comparison to TerraNova's gifted identification. These analyses were considered to be exploratory given the sample size and the characteristics of the sample; this study constitutes a step in the validation process of the Aurora Battery and will provide the basis for future research with larger and more diverse populations.

Results

Criterion validity

The first set of analyses in this study was devoted to further estimate Aurora's criterion validity. Because of the varying delays between the test-administrations of the TerraNova and the Aurora Battery, we controlled for this possible source of variation in a set of partial correlations between both measures. The resulting inter-correlations are displayed in Table 2.

As expected, results indicate a medium-level, on average, convergence between Aurora's and TerraNova's scores, with the average of 35.2 per cent and the range of nine per cent to 58 per cent of shared variance between scales. Consistent with theoretical expectations, the highest correlations between TerraNova's total score and Aurora's aptitudes scores were observed with the Analytical and Practical scores (46 per cent and 58 per cent of shared variance, respectively) whereas the Creative abilities are not directly measured by and are only limitedly represented in TerraNova's total

Table 2: Partial correlations between TerraNova and Aurora scores.

	TerraNova			
Aurora Battery	Reading	Language	Math	Total
Analytical	.55	.62	.61	.68
Creative	.37	.30	.31	.37
Practical	.62	.66	.71	.76
Images	.48	.49	.51	.56
Words	.64	.64	.57	.69
Numbers	.49	.55	.68	.67
Ability Index	.63	.66	.67	.75

Note: N=125. Partial correlations are controlled for administration delay between both measures. All coefficients are significant at p<.001.

score (13.6 per cent of shared variance). In terms of Aurora's domain scores, the results support both the convergent and divergent validity of the Aurora Battery with the TerraNova, given the pattern of intercorrelations: Aurora's Numbers domain score is mostly related to TerraNova's Math score, which presents numerical content (46 per cent of shared variance), and is less related to Reading and Language, which present verbal content (24 per cent and 30 per cent of shared variance, respectively); while Aurora's Words domain score is mainly associated with TerraNova's Reading and Language scores (41 per cent of shared variance), and is less related to TerraNova's Math score (32 per cent of shared variance). Aurora's Figural domain score is only moderately related to all of the TerraNova's domain scores (23 per cent to 26 per cent of shared variance), which was expected given that the figural domain is not highly represented in the items of TerraNova. As a whole, these results are highly consistent with theoretical expectations and provide preliminary evidence of Aurora's criterion validity with a well-established measure.

Sensitivity and Specificity of Aurora scores

The second set of analyses in this study focused on the nature of gifted identification with Aurora. To identify gifted students for each of Aurora's abilities and domains, we used a 90th-percentile threshold above which scores are considered to reflect exceptional abilities (i.e. top 10 per cent performance), consistent with prior research (Kornilov et al., 2012) and the guidelines of educational practice (Tan et al., 2009). The same procedure was used for the TerraNova total score. The resulting classifications (i.e. gifted vs. non-gifted) were used in a series of contingency analyses indicating the extent to which Aurora and TerraNova scores converge in identifying gifted children. Results were interpreted in terms of Aurora's Sensitivity (percentage of individuals simultaneously classified as gifted by both measures) and Specificity (percentage of individuals simultaneously classified as non-gifted by both measures). Table 3 summarises the Specificity and Sensitivity estimates for each Aurora ability and domain, as well as the percentage of agreement (overlap) between both classification systems (i.e., classifications resulting from Aurora and from TerraNova).

As indicated in Table 3, both measures converge highly for the identification of non-gifted students (agreement between both classification systems ranging from 90 per cent to 96 per cent), while both measures yield rather divergent identification of gifted students, as evidenced by the low to

Table 3: Summary of sensitivity and specificity of Aurora scores.

Aurora Score	TerraNova Scale Score Total		$\chi^2(1)$	*p*
	Specificity (% True Negative)	Sensitivity (% True positive)		
Analytical	83.7 (92.6%)	3.7 (38.5%)	12.20	.001
Creative	81.2 (90%)	1.5 (15.4%)	.36	NS
Practical	85.9 (95.1%)	5.9 (61.5%)	40.50	.001
Images	84.5 (94%)	4.7 (46.2%)	20.70	.001
Words	82.1 (90.9%)	2.2 (23.1%)	2.45	NS
Numbers	86.7 (95.9%)	6.7 (69.2%)	53.60	.001
Ability Index	85.2 (94.3%)	4.4 (46.2%)	22.05	.001

Note: Specificity index is calculated as a % of the total sample identified as non-gifted by both measures (% True negative=% agreement in classifying the participants as non-gifted). Sensitivity index is calculated as a % of the total sample identified as gifted by both measures (% True positive=% agreement in classifying the participants as gifted).

moderate classification agreement rate, with the average of 42.9 per cent and the range from 15.4 per cent to 69 per cent agreement. In particular, students identified as gifted through their Creative abilities as measured by Aurora and those identified as gifted by their performance in Aurora's Words domain significantly differed from those identified as gifted by the TerraNova. As a whole, the results suggest that while both Aurora and the TerraNova are able to similarly distinguish non-gifted students, the measures diverge greatly with regard to which students are identified as gifted. Despite the reasonable amount of children identified as gifted according to both instruments, the divergence between the measures suggests that the Aurora Battery is able to identify gifted children in specific areas (verbal, numerical, and figural) and with specific abilities (analytical, creatively and practical) that are not captured with traditional measures of academic achievement.

Discussion and conclusion

In this article, we focused on the Aurora Battery, an assessment designed to identify gifted students using a broader perspective, taking into account multiple abilities that are often regarded as insignificant ingredients of individuals' success in school settings and beyond. As Aurora is a newly-developed instrument, multiple strands of evidence are needed to demonstrate and establish its sound psychometric properties, its sensitivity and specificity for gifted identification, and its potential as a monitoring tool to be used in gifted education.

Consistent with previous work presenting encouraging results with regard to Aurora's psychometric features (e.g. Kornilov et al., 2012) the data presented here complement and extend these earlier results by suggesting Aurora's criterion validity with the TerraNova, an established measure of academic achievement, which provides evidence of both convergent and discriminant validity. Specifically, while overlap between some Aurora and TerraNova subscales exists and some abilities measured with Aurora – the creative abilities, in particular – are only minimally represented in TerraNova's constructs. Therefore, this suggests that Aurora taps into another type of abilities, and consequently, may further contribute to a broader identification of giftedness.

In line with this hypothesis, a Sensitivity-Specificity analysis indicated a reasonable overlap between Aurora's and TerraNova's ability to distinguish non-gifted students, but only weak agreement between the measures regarding the identification of gifted children. Together, these results suggest that, although some overlap exists between Aurora and traditional measures of academic achievement, both measures tend to result in rather different identification of gifted children, which has important implications for gifted education as one must make informed choices when deciding on gifted identification tools.

In sum, this study represents a step in the validation processes of the Aurora Battery and an important step forward for gifted education. The promise that the Aurora Battery holds in the field of gifted education is noteworthy, as it will allow many who previously would have not been identified to be identified and thus have the opportunity to further develop their potential. The Aurora Battery, based on Sternberg's Theory of Successful Intelligence, is an assessment tool that will allow for the identification of high ability in the areas of analytical, creative and practical abilities across the domains of images, numbers and words. The identification of these abilities and the nurturing of them will lead to the development of the most important form of capital, human capital.

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