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How children's intellectual profiles relate to their cognitive, socio-emotional, and academic functioning

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ABSTRACT
Intellectual abilities are consistently found to be associated to child functioning. To date, however, it is unclear how varying intellectual profiles relate to differential aspects of child functioning. We screened 513 fifth-grade children on their intellectual abilities and selected three groups of gifted children, scoring in the top 10%: analytically gifted (n = 14), creatively gifted (n = 18), and analytically creatively gifted (n = 13). Of the remaining typically developing children, a group of 152 children was selected. We examined how these groups differed in cognitive, socio-em otional, and academic aspects of child functioning. A comparison of the gifted group as a whole versus the typically developing group, showed higher scores for the gifted group on cognitive functioning, self-concept, and academic functioning. Fine-grained group comparisons showed especially the analytical-creative subgroup to score higher than the typically developing group on visual and verbal short term memory (STM), motivation, and self-concept. Furthermore, both creatively gifted subgroups outperformed the typically developing group regarding vocabulary, while all three gifted subgroups outperformed the typically developing group regarding arithmetic. A combination of high analytical and creative abilities, which was found in 2.5% of the sample, thus seemed to lead to enhanced functioning in all three domains (i.e. cognitive, socio-emotional, and academic).

Abbreviation: STM = Short term memory HSD = Honestly Significance Difference

KEYWORDS
Intelligence; creativity; giftedness

Ever since the introduction of a general intelligence factor (i.e. *g*-factor) by Spearman (1904), IQ is at the foundation of most theories of giftedness. As a consequence, children's levels of intellectual abilities are still most commonly assessed with IQ tests (McClain & Pfeiffer, 2012). Next to the largely analytical abilities assessed in IQ tests, most theories agree that creative abilities are an important additional aspect of intelligence (Ziegler

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& Heller, 2000). Previous research has shown that there is great variation in intellectual profiles (Kornilov, Tan, Elliott, Sternberg, & Grigorenko, 2012; Sternberg, Grigorenko, Ferrari, & Clinkenbeard, 1999). It is, however, unclear how differences in intellectual profiles relate to differential aspects of child functioning. Both analytical and creative intellectual ability levels are assumed to be related to children's cognitive (Miller & Vernon, 1992; Paulus & Brown, 2007) and academic development (Laidra, Pullmann, & Allik, 2007; Palaniappan, 2007). In addition, children with high levels of analytical and/or creative abilities are also often found to differ from typically developing children with regard to their socio-emotional functioning (Subotnik, Olszewski-Kubilius, & Worrel, 2011). The relation between intellectual profiles and cognitive, socio-emotional, and academic functioning has however not yet been examined in one design. Therefore, the present study examined whether upper primary school children with varying types of intellectual profiles differed in cognitive, socio-emotional, and academic functioning.

With regard to gifted and typically developing children's cognitive functioning, research consistently shows levels of analytical abilities, such as analyzing and comparing, to be associated with memory capacity (Benedek, Jauk, Sommer, Arendasy, & Neubauer, 2014). Especially working memory ability, the encoding of information, holding it in memory, and consequently performing mental operations with it, is considered to be an important cognitive process in analytical tasks (Kolligian & Sternberg, 1987). In the extensively studied Cattell-Horn-Carroll model of intelligence (McGrew, 1997), memory abilities belong to the broad ability domains. In addition, a similar role for working memory capacity is suggested for creative processes, because the generation of new ideas puts a high demand on retrieval from memory (Paulus & Brown, 2007). Although the relationship between working-memory and high levels of both analytical and creative abilities is thus well established, the relationship between short-term memory capacity and both types of abilities is less clear.

Next to differences in cognitive functioning, children with diverse patterns of intellectual abilities might also differ in their socio-emotional functioning. As a first indicator of socio-emotional functioning, children might differ in their experience of social and learning situations that are emotionally and motivationally loaded (Järvelä, 2012). The expectancy-value theory, for example, posits that motivation arises when a task is worth doing in combination with the expectation that the task is doable (Eccles et al., 1983). In line with this hypothesis, longitudinal research has shown that analytically gifted children have higher levels of academic intrinsic motivation than a comparison group of typically developing children at the ages 9–13 years (Gottfried & Gottfried, 1996). Moreover, according to the intrinsic motivation hypothesis of creativity (Amabile, 1996), motivation also enhances aspects of creativity, such as curiosity, cognitive flexibility, and risk taking behavior. This hypothesis states that high levels of interest and involvement result in higher creative performances. In support of this hypothesis, Zhang and Bartol (2010) showed that intrinsic motivation is positively related to creative performance. This effect was found to be mediated by creative process engagement, which is the engagement in idea generation, problem identification, and information searching.

A second indicator of socio-emotional functioning is self-concept. Self-concept has consistently been found to be related to the academic development of both gifted and typically developing children (Hoogeveen, Van Hell, & Verhoeven, 2009; Verschueren & Gadeyne, 2007). Self-concept is often defined as "an organized informational summary of perceived facts about oneself, including such things as one's traits, values, social roles, interests, physical characteristics, and personal history" (Bergner & Holmes, 2000, p. 36). Whereas research on differences in self-concept between gifted and typically developing children showed mixed results (Neihart, 1999), an early review study showed a small positive effect in favor of gifted children (Hoge & Renzulli, 1993).

The evidence regarding well-being as a third socio-emotional indicator is less unequivocal. Some studies suggested that giftedness enlarges vulnerability to adjustment difficulties, whereas in other studies it was suggested that giftedness protects children from maladjustment (Neihart, 1999). According to the review by Neihart (1999), it can only be concluded that the level of psychological well-being of gifted children is related to other factors than solely intellectual abilities, including educational fit and life circumstances. A more recent review by Francis, Hawes, and Abbott (2015) showed superior socio-emotional adjustment for gifted children compared to their typically developing peers.

Concerning academic functioning, the influence of analytical abilities is most extensively studied and acknowledged (Subotnik et al., 2011). High levels of analytical abilities are generally found to be related to higher school achievements (e.g. Deary, Strand, Smith, & Fernandes, 2007). Even in the top 1% of young adolescents, individual differences in general intellectual ability levels were related to differences in educational outcomes (Robertson, Smeets, Lubinski, & Benbow, 2010). A positive relationship between creativity and academic achievements was first reported in 1962 (Getzels & Jackson, 1962) and has consistently been supported in more recent studies (e.g. Mandelman, Barbot, Tan, & Grigorenko, 2013). With regard to differences between children with varying intellectual profiles, a study by Palaniappan (2007) showed that analytically creatively gifted children attained higher academic achievements than children with low levels of abilities in both domains. No differences were, however, found between analytically creatively gifted children and children gifted in either one of these domains. In contrast, Cleanthous, Pitta-Pantazi, Christou, Kontoyianni, and Kattou (2010) found children with both high analytical and high creativity scores to attain higher arithmetic scores than children with gifted levels of either analytical or creative abilities.

Altogether, previous research has shown that levels of analytical and creative abilities are positively related to children's cognitive, socio-emotional, and academic functioning. According to the theory of triarchic intelligence (Sternberg, 1985, 2011); however, a third type of ability is of equal importance as analytical and creative abilities to reach success in life: practical abilities. Practical abilities are required to adapt to, shape, and select environments so that the change of success is further enhanced. In contrast to the well-documented effects of analytical and creative abilities in relation to child-functioning, however, the role of practical abilities has only been examined with regard to academic functioning. Moreover, the few studies that did incorporate practical abilities, showed inconsistent results. Whereas some studies showed a positive effect on academic achievements (Heng, 2000; Koke & Vernon, 2003; Mandelman et al., 2013) others did not find a significant relationship (Ekinci, 2014), or found the relationship to be negative (Sternberg et al., 2001). Nevertheless, results by Kornilov et al. (2012) suggested that it might be valuable to also take practical abilities into account, with practical abilities being predictive of variance in achievement test scores, next to analytical and creative abilities.

Summarizing, previous studies suggest that a variety of intellectual profiles can be identified and that variation in these intellectual profiles is related to child functioning. Thus, it is important to recognize this variation in order to shed more light on the individual variation in gifted children (Kornilov et al., 2012). Moreover, with insight in children's intellectual profiles as well as their cognitive, socio-emotional, and academic functioning, teaching can be aligned to individual differences between children. Sternberg et al. (1999) showed that gifted students perform best in both the intellectual and cognitive domain when instruction is matched to their pattern of abilities. However, most studies based their selection of gifted children on analytical IQ and performance tests (McClain & Pfeiffer, 2012) and it is still by no means clear how varying profiles of intellectual abilities relate to differential aspects of child functioning. To the best of our knowledge, no previous study explored differences between the three areas of child functioning in children with varying intellectual profiles within one design.

The present study first explored differences in cognitive, socio-emotional, and academic functioning between gifted children and typically developing children. Second, we examined what intellectual profiles can be distinguished in upper primary school children. Based on the study with the Dutch version of the Aurora Assessment Battery (Gubbels, Segers, Keuning, & Verhoeven, 2016), we expected a newly composed battery to discriminate analytical and creative abilities. In an attempt to additionally assess practical ability levels, we also included practical subtests in our newly composed assessment battery. Next, we examined how intellectual profiles of a group of upper primary school children related to their cognitive, socio-emotional, and academic functioning. Because memory abilities are considered to be associated with general intellectual abilities and creativity, we expected both analytically and creatively gifted children to have higher short term memory (STM) abilities than typically developing children with children gifted in both domains showing highest STM scores. Moreover, we expected children with gifted levels of analytical abilities (i.e. analytically and analytically creatively gifted children) to have higher levels of motivation (Gottfried & Gottfried, 1996) and self-concept (Hoge & Renzulli, 1993) than typically developing children, because their abilities are more likely to be acknowledged. Based on the intrinsic motivation hypothesis of creativity, we also hypothesized creatively gifted to rate their level of motivation higher than typically developing children, yet no differences were expected in self-concept between creatively gifted and typically developing children. For well-being, mixed results have been found (Neihart, 1999) so that no concrete hypothesis was formulated. Ultimately, in the face of the expected positive effect of analytical abilities on academic achievements and the analytical focus of academic achievement tests, higher vocabulary and arithmetic scores were hypothesized for analytically gifted and analytically creatively gifted children when compared to typically developing children. We did not expect children gifted in the creative domain only to outperform typically developing children in academic functioning. Research on the functioning of practically gifted children is sparse and inconsistent, yet based on the theory of triarchic intelligence we expected children with high levels of abilities in the practical as well as analytical and creative domain to be most successful and thus show the highest cognitive, socio-emotional, and academic functioning scores.

Method

Participants

The study was announced on a national online platform that brings together educational professionals (e.g. teachers, principals) and experts. In addition, two experts in the field of giftedness brought the study to attention to schools in their network. This resulted in a school sample of 15 primary schools across the Netherlands with a total of 513 fifth-grade children. All children participated in a screening of their analytical and creative abilities. Following Kornilov et al. (2012), we identified children with top 10% scores in either one or both intellectual domains as gifted (n = 52;). All other children (n = 461) were identified as typically developing.

For the present study, we invited all gifted children to complete cognitive, socio-emotional, and academic assessments. Due to practical reasons, typically developing children of only half of the schools were invited to complete these measures. This resulted in a subsample of 203 typically developing children. During the course of the study, one school withdrew from participation, so that 30 children (1 gifted; 29 typically developing) were excluded from all subsequent analyses. In addition, 22 typically developing and six gifted children were absent at one of the measurement occasions. Therefore, their scores were excluded from analyses as well. Results thus represent child functioning scores of 45 gifted (23 boys; 22 girls) and 152 typically developing children (78 boys; 74 girls). The mean age was 10 years and 4 months for the typically developing children. The mean ages of the three groups of gifted children were 10 years and 5 months for the analytically gifted and analytically creatively gifted children and 10 years and 4 months for the creatively gifted children. These differences were nonsignificant, $F(3,193) = 0.46$, $p = .712$.

Measures

Intellectual abilities

Although the Aurora Assessment Battery (Chart, Grigorenko, & Sternberg, 2008) was developed to assess analytical, creative, and practical abilities in upper primary school children, a previous study showed an inadequate fit between the Dutch version of the Aurora and the triarchic model of intelligence (Gubbels et al., 2016). That is, the Aurora battery as a whole did not discriminate between analytical and practical abilities. Creative abilities, however, could be successfully discriminated with the Aurora subtests. In addition, reliability statistics of some of the individual subtests were acceptable to high. In the present study, we composed a test battery with good-working Aurora subtests and complemented this with standardized test of intellectual abilities.

Three subtests from the Dutch Intelligence Test for Education Level (Van Dijk & Tellegen, 2004) assessed analytical abilities: *Analogies, Numbers*, and *Figures*. With *Analogies* (α = .64), children had to mark which of five words would follow a series of three words most properly. Therefore, they should analyze the relationship between the first two words and apply this to the third word. In the subtest *Numbers* (α = .85), children were provided with a series of numbers for which they had to indicate which of five alternatives would be the correct successive number in the series. Both *Analogies* and *Numbers* comprised 25 multiple choice items. The subtest *Figures* (α = .69) consisted of eight multiple choice items.

Children had to indicate which out of five paper models could be folded into a three dimensional figure. Every correctly marked alternative was worth one point, whereas every wrongly marked alternative reduced the score with one point.

We included the subtest *Toy Shadows* of the Aurora and the *Practical Intellect* subtest of the Dutch version of the Differential Aptitude Test (Fokkema & Dirkzwager, 1968) in an attempt to assess practical abilities. In each of the eight items in the *Toy Shadows* subtest (α = .53), a photograph is shown of a light shining on a toy at a particular angle. Children must then select from four other photographs the picture showing the actual corresponding cast shadow. *Practical Intellect* (α = .79) consisted of 50 multiple-choice questions in which a practical problem was presented.

The Aurora subtests *Book Covers, Multiple Uses*, and *Metaphors* assessed creative abilities. *Book Covers* (α = .89) comprised five images that should be interpreted as book covers. Children had to write down, thereby expressing their creativity, what the books could be about. *Multiple Uses* (α = .76) asked children to write down unusual uses for five common objects. With *Metaphors* (α = .75), children had to elaborate on the similarities between two common objects. Although this subtest was included as an analytical subtest in the original Aurora Battery, the study by Gubbels et al. (2016) showed that scores on the *Metaphors* were more indicative of creative than analytical abilities. All open-ended answers were polytomously coded on accuracy and creativity by three trained coders. The percentage of agreement between raters was 72.2% for *Book Covers*, 80.2% for *Multiple Uses*, and 73.8% for *Metaphors*.

Cognitive functioning

The subtest *Remembering Images* of the Dutch Differentiatie Testserie (Van Hoorn, Van Der Kamp, & Den Brinker, 2004) assessed visual short-term memory (STM) abilities. After observing two times 10 images for a minute, pupils had to write down as many images as they remembered. This procedure was then repeated with 20 new images.

The subtest *Word Couples* of the Dutch Differentiatie Testserie assessed verbal short-term memory (STM) abilities. The test assistant read aloud a list of 10 word couples. Subsequently, the assistant read aloud one of the two words and the pupils had to write down the other. Immediately afterward, this procedure was repeated with the same list of items.

Socio-emotional functioning

Children rated 80 statements from the *Dutch School Attitude Questionnaire* (Vorst, Smits, Oort, Stouthard, & David, 2008) addressing their motivation for schoolwork (α = .89), their self-concept regarding school and social achievements (α = .88), and their well-being in school

(α = .86). All items were rated on a three points Likert scale (*1 = do not agree; 2 = no opinion; 3 = agree*).

Academic functioning

Vocabulary and arithmetic skills were assessed with items from the Dutch national Monitoring and Evaluation System (see Vlug, 1997). The mean degree of difficulty of items stemming from this monitoring and evaluation system is .70. To increase differentiation between the gifted groups, we selected more difficult items so that the mean degree of difficulty was .48 for the vocabulary (α = .78) and .51 for the arithmetic test (α = .87). For *Vocabulary*, 40 multiple-choice items addressed children's knowledge of word meanings, synonyms, and antonyms. The *Arithmetic* test comprised 23 open-ended items and one multiple-choice item tapping into basic arithmetic skills such as counting, subtracting, dividing, multiplying, and calculating with fractions and percentages.

Procedure

A research assistant visited the classrooms twice. During the first visit, children completed the intellectual screening battery in a classroom setting in two 1-hour sessions. After scoring and analyzing these data, a subsample of 225 children was invited to complete measures with regard to their cognitive, socio-emotional, and academic functioning. Again, the assistant visited the classroom and explained the procedure to the children. Children then filled out all subtests in two one-hour classroom sessions.

Statistical analyses

First, we performed correlation and exploratory factor analyses to examine the underlying structure of the intellectual abilities battery. Since the types of abilities are hypothesized to be distinct but correlated (Kornilov et al., 2012), we used an oblique rotation method (i.e. OBLIMIN). Weighted factors scores were used as indicator of children's level of intellectual abilities. More specifically, sum scores were created by multiplying the factor loading of a subtest by the score on that subtest. Next, correlations between the intellectual measures and the three measures of cognitive, socio-emotional, and academic functioning measures were calculated. To correct for the increased chance of Type I error and significant correlations, we conducted a Bonferroni correction on these analyses.

Children with top 10% scores in either the analytical or creative domain were identified as gifted. We first analyzed differences in cognitive, socio-emotional, and academic functioning between gifted children and typically developing children. Next, we examined differences in cognitive, socio-emotional, and academic functioning between the four groups of children with varying intellectual profiles (i.e. analytically gifted, creatively gifted, analytically creatively gifted, typically developing children) in more detail using a MANOVA. Since *n* varied largely and we were interested in all pairwise comparisons between groups, we used the conservative Tukey's Honestly Significance Difference (HSD) with Kramer modification in *post hoc* tests (Day & Quinn, 1989).

Results

Intellectual profiles

Table 1 presents correlations between the eight intellectual ability subtests. Results showed substantial positive correlations between the three analytical subtests as well as between the three creative subtests. Although correlations between the two practical subtests were also significant, the two practical subtests correlated more strongly with the three analytical subtests Analogies, Numbers, and Figures than with each other. In addition, the subtest Metaphors correlated more strongly with the creative subtests than with the other analytical subtests.

An exploratory factor analysis examining the factor structure of the newly composed battery supported these correlational results. Based on the scree plot and the Kaiser Criterion that factors with an *eigenvalue* greater than 1 should be considered significant (Kaiser, 1960), two factors were extracted. The correlation between both factors was 0.41. Table 2 shows uniqueness statistics and oblique rotated factor loadings for all subtests. Both the analytical and the practical subtests were found to load substantially to the first factor. The formats of the practical ability tests partly resembled tacit knowledge tests that ask for a situational judgment of an everyday practical situation (Cianciolo et al., 2006). Formats of both

Table 4 Descriptive Statistics of Intellectual, Cognitive, Socio-Emotional, and Academic Measures in the Groups with Varying Intellectual Profiles

	TD		Gifted		A+		C+		AC+	
	(*n* = 152)		(*n* = 45)		(*n* = 14)		(*n* = 18)		(*n* = 13)	
	M	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)
Analytical abilities	-0.05	(0.74)	1.16	0.69	1.51	(0.33)	0.50	(0.48)	1.19	(0.19)
Creative abilities	-0.07	(0.55)	1.01	.51	0.40	(0.45)	1.19	(0.19)	1.40	(0.17)
Visual STM	22.32	(4.78)	25.07	4.86	25.00	(4.15)	23.89	(5.41)	26.77	(4.60)
Verbal STM	14.64	(4.15)	16.76	3.52	16.07	(4.83)	16.61	(2.89)	17.69	(2.63)
Motivation	57.68	(9.43)	60.31	9.25	55.71	(12.19)	60.67	(7.19)	64.77	(5.78)
Self-concept	58.68	(9.01)	63.58	7.24	63.50	(4.27)	61.50	(9.65)	66.54	(4.91)
Wellbeing	65.41	(6.53)	67.00	5.22	66.14	(6.82)	67.06	(4.89)	67.85	(3.76)
Vocabulary	17.61	(5.59)	23.89	6.52	21.71	(4.45)	23.22	(5.74)	27.15	(8.38)
Arithmetic	11.52	(5.29)	16.53	4.50	16.29	(4.68)	14.83	(4.58)	19.15	(2.97)

Note. TD= typically developing; A+ = analytically gifted; C+ = creatively gifted; AC+ = analytically creatively gifted;

Table 2. Oblique rotated factor loadings.

		Loadings	
	Uniqueness	Analytical abilities	Creative abilities
Analogies	.634	**.599**	.015
Numbers	.655	**.584**	.006
Figures	.678	**.540**	.060
Toy shadows	.864	.346	.048
Practical intellect	.638	**.634**	−.093
Book covers	.783	−.085	**.493**
Multiple uses	.730	.130	**.453**
Metaphors	.769	.068	**.448**

Note. Rotated factor loadings > .40 are in boldface.

subtests, however, also resemble with general reasoning subtests. Because the distinction between analytical and creative abilities is acknowledged in almost all models of giftedness, whereas practical abilities as a third type of ability is less evidenced, we chose to label Factor 1 as an indicator of analytical abilities. The three creative subtests were found to load substantially to the second factor. Although the Metaphors subtest was included as an analytical subtest in the original Aurora Battery, results of the factor analysis are in line with the study by Gubbels et al. (2016) showing that scores on the Dutch version of the *Metaphors* subtest were indicative of creative abilities. Weighted regression factor scores for analytical and creative abilities were computed. These two weighted factor scores were used in subsequent analyses

Table 3 presents correlations between intellectual, cognitive, socio-emotional, and academic measures. Analytical and creative ability scores were found to be correlated. In addition, the significant correlations between both types of intellectual abilities and the cognitive and academic measures indicated that higher levels of intellectual abilities were associated with better functioning in both domains. Creative abilities also correlated significantly with the socio-emotional measures, yet for analytical abilities, only the correlation with self-concept was significant.

Table 3. Correlations between intellectual, cognitive, socio-emotional, and academic measures.

		1	2	3	4	5	6	7	8	9
1	Analytical abilities	-								
2	Creative abilities	.563*	-							
3	Visual STM	.407*	.353*	-						
4	Verbal STM	.313*	.265*	.329*	-					
5	Motivation	.148	.308*	.187	.057	-				
6	Self-concept	.304*	.314*	.151	.120	.442*	-			
7	Well-being	.103	.224*	.129	.151	.501*	.347*	-		
8	Vocabulary	.495*	.450*	.285*	.303*	.206*	.195*	.297*	-	
9	Arithmetic	.621*	.425*	.251*	.358*	.249*	.235*	.383*	.560*	-

Note. STM = Short-term memory; * $p \leq .05$ with Bonferroni correction.

Table 4. Descriptive statistics of intellectual, cognitive, socio-emotional, and academic measures in the groups with varying intellectual profiles.

	TD (*n* = 152)		Gifted (*n* = 45)		A+ (*n* = 14)		C+ (*n* = 18)		AC+ (*n* = 13)	
	M	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)	*M*	(SD)
Analytical abilities	−0.05	(0.74)	1.16	0.69	1.51	(0.33)	0.50	(0.48)	1.19	(0.19)
Creative abilities	−0.07	(0.55)	1.01	.51	0.40	(0.45)	1.19	(0.19)	1.40	(0.17)
Visual STM	22.32	(4.78)	25.07	4.86	25.00	(4.15)	23.89	(5.41)	26.77	(4.60)
Verbal STM	14.64	(4.15)	16.76	3.52	16.07	(4.83)	16.61	(2.89)	17.69	(2.63)
Motivation	57.68	(9.43)	60.31	9.25	55.71	(12.19)	60.67	(7.19)	64.77	(5.78)
Self-concept	58.68	(9.01)	63.58	7.24	63.50	(4.27)	61.50	(9.65)	66.54	(4.91)
Well-being	65.41	(6.53)	67.00	5.22	66.14	(6.82)	67.06	(4.89)	67.85	(3.76)
Vocabulary	17.61	(5.59)	23.89	6.52	21.71	(4.45)	23.22	(5.74)	27.15	(8.38)
Arithmetic	11.52	(5.29)	16.53	4.50	16.29	(4.68)	14.83	(4.58)	19.15	(2.97)

Note. TD = typically developing; A+ = Analytically gifted; C+ = Creatively gifted; AC+ = Analytically creatively gifted.
* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Differences between gifted and typically developing children

Based on the top 10% criterion, a total of 45 gifted children were identified as being gifted.

Gifted and typically developing children did not differ with regard to age, $t(195) = 0.91$, $p = .362$, $d = 0.16$, or gender, $\chi^2(1, N = 197) < .01$, $p = .981$, Cramér's $V < .01$. Table 4 presents means and standard deviations for the intellectual measures as well as the cognitive, socio-emotional, and academic measures for the gifted and typically developing children. Gifted and typically developing children differed in cognitive functioning. In visual STM, gifted children outperformed typically developing children, $t(195) = 3.38$, $p = .001$, $d = 0.57$. Similarly, gifted children gained higher scores than typically developing children for verbal STM, $t(195) = 3.10$, $p = .002$, $d = 0.55$. With regard to both motivation, $t(195) = 1.65$, $p = .101$, $d = 0.28$, and well-being, $t(195) = 1.50$, $p = .135$, $d = 0.27$, gifted and typically developing children did not differ. Gifted children, however, did report higher levels of self-concept than their typically developing peers, $t(195) = 3.3$, $p = .001$, $d = 0.60$. In addition, differences in academic functioning between gifted children and typically developing children were also significant, respectively $t(195) = 6.37$, $p < .001$, $d = 1.03$ for vocabulary, and $t(195) = 5.77$, $p < .001$, $d = 1.02$ for arithmetic.

Variation in intellectual, cognitive, socio-emotional, and academic measures

Based on their intellectual profiles, gifted children were further classified over three groups: 14 children were only in the top 10% regarding their analytical abilities and were classified as analytically gifted (i.e. A+). Similarly, 18 children were creatively gifted (i.e. C+), and 13 children were analytically creatively gifted (i.e. AC+). The three groups of gifted children did not differ in age, $F(2,42) = .32$, $p = .726$, $\eta^2 = .02$. The proportion of boys and girls did, however, differ between the three groups with varying gifted intelligence profiles, $\chi^2(2, N = 45) = 9.82$, $p = .007$, Cramér's $V = .47$. More boys than girls were included in the A+ group, whereas a larger proportion of girls than boys were included in the C+ group. In the combined AC+ group, the number of boys and girls was equal. Scores on the indicators of cognitive, socio-emotional, and academic functioning for the three groups of gifted children are also presented in Table 4. A one-way MANOVA with *post hoc* Tukey HSDs was performed to examine differences between the group of typically developing children and the three groups of gifted children (i.e. A+, C+, AC+).

Results confirmed that the four groups differed in their level of analytical, $F(3, 193) = 45.76$, $p < .001$, $\eta^2 = .42$, and creative abilities, $F(3, 193) = 63.11$, $p < .001$, $\eta^2 = .49$. As expected in face of the classification, children in the A+ and AC+ groups outperformed typically developing ($p < .001$, Hedges' $g > 1.73$) and C+ children ($p < .001$, Hedges' $g > 1.78$) on the analytical subtests, whereas no difference was found between the A+ and AC+ group ($p = .893$, Hedges' $g = 1.18$). The group of C+ children, however, also showed significantly higher analytical scores than typically developing children ($p = .008$, Hedges' $g = 0.77$), indicating that their level of analytical ability fell in between that of the typically developing and analytically gifted groups. A similar pattern was found for creative abilities. Children in the C+ and AC+ did not differ in creativity level ($p = .679$, Hedges' $g = 1.15$), therewith both outperforming typically developing ($p < .001$, Hedges' $g > 2.40$) and A + children ($p < .001$, Hedges' $g > 2.40$), whereas creativity scores of the A+ group of children were higher than those of the typically developing children($p = .005$, Hedges' $g = 0.87$).

Data were normally distributed for all measures, except for the well-being measure. Well-being was left-skewed, yet this was equal in all four groups. Three cases were identified as outlier for well-being. For self-concept, one case was identified as outlier. To check whether results were not mainly the result of these cases, we repeated all analyses without these four cases. This did not change any of the results reported in the following text.

Again, a MANOVA was performed to assess differences between the four groups of children. First, with regard to the cognitive measures, results showed significant differences between the four groups of children for both visual STM, $F(3, 193) = 4.74$, $p = .003$, $\eta^2 = .07$, and verbal STM, $F(3, 193) = 3.56$, $p = .015$, $\eta^2 = .05$. Tukey's HSD *post hoc* tests showed higher levels of both visual ($p = .008$, Hedges' $g = 0.93$) and verbal STM ($p = 0.047$, Hedges' $g = 0.75$) for AC+ than typically developing children, whereas A+ and C+ children did not differ from their typically developing peers ($p < .188$, 0.32

≤ Hedges' *g* ≤ 0.57). In addition, the three groups of gifted children also did not differ in STM ($p < .351$, 0.14 ≤ Hedges' *g* ≤ 0.57).

Second, concerning socio-emotional development, motivation, $F(3, 193) = 3.08$, $p = .029$, $\eta^2 = .05$, and self-concept ratings, $F(3, 193) = 4.59$, $p = .004$, $\eta^2 = .07$, differed significantly between groups. *Post hoc* tests again indicated higher ratings for both motivation ($p = .044$, Hedges' $g = 0.77$) and self-concept ($p = .010$, Hedges' $g = 0.90$) for AC+ children than typically developing children. Again, children gifted in either one of the intellectual domains (i.e. A+ or C+ children) did not differ from typically developing children or analytically creatively gifted children ($p < .058$, 0.20 ≤ Hedges' *g* ≤ 0.94). Well-being ratings were similar for all four groups, $F(3, 193) = 0.91$, $p = .437$, $\eta^2 = .01$.

Third, MANOVA results illustrated significant differences in both vocabulary, $F(3, 193) = 15.97$, $p < .001$, $\eta^2 = .25$, and arithmetic scores, $F(3, 193) = 13.15$, $p < .001$, $\eta^2 = .17$. Typically developing children gained lower vocabulary scores than both groups of creatively gifted children ($p \leq .001$, 1.00 ≤ Hedges' *g* ≤ 1.63). For arithmetic, all three groups of gifted children were found to outperform the typically developing children ($p \leq .046$, 0.63 ≤ Hedges' *g* ≤ 1.48). All comparisons between the three groups of gifted children were again nonsignificant ($p < .093$, 0.32 ≤ Hedges' *g* ≤ 1.08).

Discussion

Current theories of intelligence and giftedness emphasize the role of multiple types of abilities in reaching success (Ziegler & Heller, 2000). The present study aimed to examine differences in cognitive, socio-emotional, and academic functioning of upper primary school children with varying intellectual ability profiles. More specifically, we examined whether children with both high analytical and high creative abilities perform better than children with high levels of abilities in either one of the domains and typically developing children. Despite our attempts to design a triarchic assessment battery based on established analytical, creative, and practical subtests, we could not explicate the role of practical abilities. Whereas both the Toy Shadows (Tan et al., 2012) and the Practical Intellect subtest (Fokkema & Dirkzwager, 1968) had been shown to reflect practical abilities, in our study scores seemed to coincide with analytical subtest scores. This high overlap was also found in a study by Mandelman, Tan, Kornilov, Sternberg, and Grigorenko (2010) and supported by the widely acknowledged differentiation between analytical and creative abilities. It is, however, in contrast with the claim for practical abilities as a third type of abilities by the theory of triarchic intelligence (Sternberg, 1985). This may be due to the fact that the participating children formed a rather homogeneous, high SES group, also with little cultural variation. Previous research has however shown that especially children from ethnic minorities and economically disadvantaged families profit from multidimensional assessment batteries including practical abilities (Stemler, Grigorenko, Jarvin, & Sternberg, 2006; VanTassel-Baska, Johnson, & Avery, 2002). Although analytical and creative ability levels were also related, we were able to distinguish groups of analytically gifted, creatively gifted, analytically creatively gifted children, and a group of typically developing children.

Our results with regard to differences between children with varying types of intellectual profiles showed that gifted children have higher STM abilities than their typically developing peers. Analyses with regard to the differences between the four groups of children with varying intellectual profiles showed that especially analytically creatively gifted children had greater STM capacities than typically developing children. These results support earlier findings by Benedek et al. (2014) that levels of both analytical and creative abilities are related to short-term memory ability. The high levels of abilities in both domains might beneficially affect short-term memory abilities of the analytically creatively gifted children. The effect might, however, also be reciprocal, with higher levels of short-term memory ability enhancing the children's ability to store and compare analytical information (Kolligian & Sternberg, 1987) or use the information together with preexisting knowledge to come up with creative ideas (Paulus & Brown, 2007).

With regard to socio-emotional functioning, gifted children in general did not report higher levels of motivation than typically developing children. The analyses over the four groups, however, showed that analytically creatively gifted did surpass typically developing children in motivation. Accordingly, results were supportive of both the expectancy-value theory and the intrinsic motivation hypothesis of creativity (Amabile, 1996; Eccles et al., 1983), only in a group of children with high levels of both analytical and creative abilities. Levels of self-concept also differed between typically developing and gifted children. The small difference in self-concept that was found in a review by Hoge and Renzulli (1993) in comparison to typically developing children was however only replicated for the analytically creatively gifted children. With regard to well-being, we found gifted children to have equal levels of well-being as their typically developing peers. Although previous research showed mixed results, our results regarding children's well-being matched with results by Neihart (1999) in showing that intellectual abilities have only limited influence on the experience of well-being.

Concerning differences in academic achievement, results showed that gifted children gained higher scores on both vocabulary and arithmetic tests than typically developing children. Results of subsequent analyses again showed that this difference in academic functioning was present between the groups of children with gifted levels in both the analytical and creative domain and typically developing children. These results are in line with Palaniappan's findings (Palaniappan, 2007) that children with high IQ and high creativity attain higher academic achievement than children with low IQ and low creativity. Whereas Cleanthous et al. (2010) found children with both high analytical and high creativity scores to also attain higher arithmetic scores than children gifted in either one of these domains, no significant differences between the three groups of gifted children were found in the present study or in Palaniappan's (2007) study. These results are supportive of the threshold theory regarding creativity and intelligence (Barron, 1963; Jauk, Benedek, Dunst, & Neubauer, 2013). Scores of children with high levels of both analytical and creative abilities were only found to be enhanced when compared to typically developing children.

Children gifted in either the analytical or creative domain, however, also outperformed typically developing children in arithmetic. In contrast, higher vocabulary scores were only found for the creatively and analytically creatively gifted children when compared to typically developing children. These results are in contrast with the studies showing that creatively gifted children are less likely to be identified as being gifted with regularly used achievement tests (Mandelman et al., 2013). Although the difference in vocabulary scores between analytically gifted and typically developing children was nonsignificant, the p value (.054), the effect size (d = 0.75) was medium to large. A larger sample size may thus have shown analytically gifted children to also outperform typically developing children in vocabulary. An explanation for the finding that especially creatively gifted children outperformed the typically developing children on vocabulary might be found in the type of creativity tests used. The first creativity subtest, Book Covers, reflects storytelling abilities. The other two creativity subtests, Metaphors and Multiple Uses were constrained production tasks (Lubart, Pacteau, Jacquet, & Caroff, 2010) asking children to write down multiple similarities or unusual uses. Although subtests thus comprise the two most frequently used types of creativity assessments (Lubart et al., 2010), all three subtests depend strongly on verbal abilities with more elaborate and original answers bearing higher creativity scores. As a result, the vocabulary scores of the creatively gifted children might be inflated due to this focus on a verbal expression of creativity.

Of course, some limitations apply to the present study. First, the number of participants in the gifted groups was fairly small, considering that only the top 10% of our original sample was selected as gifted. Despite the small sample sizes per group, we did find some significant differences between groups. The statistical power of the current study might, however, have been too low to detect other differences between groups. The results should be interpreted with caution, given the risk of type I error in small sample sizes. Second, we used the subtest Metaphors as a creativity subtest based on the factor analysis. However, this test was originally designed to asses analytical rather than creative abilities and was thus scored as such. Third, we were not able to examine reciprocity of relationships between the cognitive, socio-emotional, and academic measures. Academic achievements might, for example, be influenced by higher levels of STM (Bull, Espy, & Wiebe, 2008), motivation (Steinmayr & Spinath, 2009), or self-concepts (Marsh & Craven, 2006). Adversely, self-concept and motivation might also be enhanced by high academic functioning (Hoge & Renzulli, 1993; Ireson & Hallam, 2009). Future research might further explore group differences based on profile analyses. In addition, it would be interesting to adopt a longitudinal design to explore causal relations in developmental patterns of cognitive, socio-emotional, and academic functioning of children with varying ability profiles over time.

In sum, the results of the present study showed that all groups of gifted children scored higher than their typically developing peers on the arithmetic tests, whereas only creatively and analytically creatively gifted children outperformed typically developing children in vocabulary. Moreover, analytically creatively gifted children outperformed typically developing children with regard to short-term memory abilities, motivation, and self-concept, suggesting that their combined giftedness does provide them with additional benefits. Most current theories on giftedness include analytical and creative abilities as key factors in their definition of giftedness. With respect to this theoretical discussion on what defines giftedness, results of our study confirm that children with high levels of both types of abilities also perform best in other domains. Therewith, results support the shift from a narrow definition of giftedness including only high IQ to a broader conception of the nature of giftedness.

In practice, however, analytical abilities are still included in the assessment of giftedness more often than creative abilities (McClain & Pfeiffer, 2012). To allow a greater range of children to be encouraged to further develop their potential, other types of abilities should be addressed in both screening and evaluation instruments. A study by Chan (2001) showed that a self-report checklist is a valuable way to assess the aspects of giftedness that are not covered by conventional measures. In addition to other assessment instruments, teachers might use techniques to teach in an analytical or creative way (Sternberg & Grigorenko, 2004). Teaching analytically means that students are encouraged to analyze relationships between two objects. Analytical teaching also includes assignments in which students should compare for example different methods in order to evaluate which one is the best. Creative teaching, on the other hand, involves activities that encourage students to create or invent new things. For creative teaching, the classroom context is of major importance (Beghetto & Kaufman, 2014) as well as having the teacher as a role model (Jaussi & Dionne, 2003). Using both methods of teaching in education and enrichment programs might enhance levels of analytical and creative abilities in both typically developing and gifted children (Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996). Moreover, previous research has shown that analytically gifted students perform best on analytical, creative, and practical as well as memorization assignments with analytical instruction. Creatively gifted children were found to perform best on these assignments with creative ways of teaching (Sternberg et al., 1999). Multidimensional assessment of abilities might thus provide insights in students' intellectual profiles that can be used to align teaching to individual patterns of strengths and weaknesses.

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