Creative Intelligence of Children with an Autism Spectrum Disorder

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Preface

Before starting the pre-master Orthopedagogics I obtained a degree in teaching music. During my studies I found out that I was interested in teaching children with Emotional and Behavioural Disorders (EBD). For these children and young adults, music was more than a compulsory subject. These children explored and showed their emotions in a new way, learned how to work with each other and together came up with the most original and striking ideas.

Studying the pre-master, I carried out qualitative research into Inclusive Education in the Netherlands. I was astonished at how employees at regular schools thought about including children with EBD in their schools and the way policymakers were talking about the problems these children were causing, for instance during lunch breaks. It then occurred to me that the education system should be more creative and less rigid; for instance, reschedule the breaks to ensure that not all the pupils are in the canteen at the same time, allow children to only move from classroom to classroom on the same floor, create a small, cosy room where children can recharge.

Financial resources, or rather the lack of them play an important role. Therefore, better use should be made of resources to fund scientific research, which is necessary to investigate the possibilities of Inclusive Education and how scientific findings can be implemented. In this study I hope to have taken a small step towards this goal. I think it is important that policymakers invest more in this kind of research and that researchers would communicate more with ‘the outside world’ about their very important, <u>creative</u> solutions to make Inclusive Education possible.

I would like to thank my loving boyfriend for reminding me to eat and sleep during this hectic graduation year. I am also grateful to my aunt for critically reading my text and helping me make my English a little more adequate. Finally, I would like to thank my supervisor Evelyn Kroesbergen for stimulating me to do my utmost throughout the year.

Samenvatting

In navolging van de wet Passend onderwijs, wordt verwacht dat het reguliere onderwijs steeds meer kinderen gaat opnemen met onder andere een stoornis binnen het autisme spectrum (ASS). Vaak ligt hierbij de nadruk op de beperkingen van deze leerlingen, terwijl er juist meer gebruik zou kunnen worden gemaakt van hun talenten. Daarom staat hier creativiteit van kinderen met ASS-centraal. Er is onderzocht hoe creatief deze kinderen zijn en of dit afhankelijk is van hun intelligentie. Kinderen met ASS (55) en kinderen zonder ASS-diagnose (55) werden getest op intelligentie en creativiteit door middel van vier verschillende tests, waaronder een test voor divergent denken en een test waarbij een holistische definitie van creativiteit werd getest. De resultaten wijzen op een positieve relatie tussen intelligentie en divergent denken. Daarentegen bleek alleen visueel-ruimtelijke intelligentie gerelateerd aan de holistische definitie van creativiteit. Verder bleek dat kinderen met ASS niet verschillen van normaal ontwikkelende kinderen in creativiteit, maar dat er wel verschillen zijn in het profiel van creatieve vaardigheden. Deze resultaten impliceren dat scholen, de wetenschap en de kunstwereld, maar ook psychologen en orthopedagogen meer uit moeten gaan van de individuele talenten van kinderen, zoals creativiteit, om zo meer kinderen te betrekken in het reguliere onderwijs en de samenleving.

Trefwoorden: autisme, creativiteit, intelligentie, 21e eeuwse vaardigheden, inclusief onderwijs

Abstract

Regular schools are expected to take in more children with an Autism Spectrum Disorder (ASD), among others. The focus is often on their disabilities, while it should be more on their talents. Creativity of children with ASD is therefore the focus of this study. This study focused on how creative these children are and whether or not this depends on their intelligence. Children (55) with ASD and children (55) without an ASD diagnosis completed four tests to measure their intelligence and creativity, including a divergent thinking test and a test to measure the holistic definition of creativity. The results showed that intelligence is positively related to creativity for children with ASD, whereas only visual-spatial intelligence turned out to be related to the more holistic definition of creativity. In addition, children with ASD do not differ in creativity from children without ASD, after controlling for the effect of intelligence. This implies that schools, science and arts, as well as psychologists and orthopedagogues should place more emphasis on the talents of every individual, such as creativity, to include more children in regular education and our society.

Keywords: Autism, creativity, intelligence, 21st century skills, inclusive education

Creative Intelligence of Children with an Autism Spectrum Disorder

"One of the greatest problems facing the world today is the growing number of persons who are excluded from meaningful participation in the economic, social, political and cultural life of their communities. Such a society is neither efficient nor safe." (United Nations Educational, Scientific and Cultural Organisation [UNESCO], 2003, pp. 3)

These past few decades, inclusion has been an important international development in education. Regular school systems are supposed to accept more children with Special Educational Needs (SEN). One of the focal points of inclusion is to emphasize the talents and possibilities of every child, instead of their disabilities (Ainscow, 2005; Ministerie van Onderwijs, Cultuur en Wetenschap, 2014). This also applies to children with an Autism Spectrum Disorder (ASD) and in order to engage them in regular education, it is important to be aware of their talents and possibilities, such as their creative skills.

Internationally, the focus on Inclusive Education started with the Salamanca Statement in 1994, initiated by UNESCO (Ainscow, 2005; Ainscow & César, 2006). Inclusive education is to combat discrimination and build an inclusive society, where every child gets the same educational opportunities (Ainscow & César, 2006; Armstrong, Armstrong, & Spandagou, 2011). Although over 92 countries signed this statement, special education still exists. Children with emotional and behavioural disorders like ASD in these schools appear to fall significantly short on reading, writing and mathematical skills (Billingsly, Fall, & Williams, 2006; Lane, 2007; Oliver & Reschly, 2010) and to have a lower intelligence quotient (IQ) (Kroesbergen, Sontag, Van Steensel, Leseman, & Van der Ven, 2010). Although efforts to realize Inclusive Education have not always been successful, schools are simultaneously trying to prepare their students for the new challenges of the twenty-first century. It is still unclear how students with SEN will fit into these new challenges and how inclusive education can be part of it (Ferguson, 2008).

Our modern society asks for more emphasis on the 21st century skills, such as workforce skills (collaboration and responsibility), applied skills (effective communication), life skills (flexibility) and personal skills (curiosity, imagination, problem solving and creativity; McComas, 2014; Saavedra & Opfer, 2012; Silva, 2009). How people apply their knowledge is becoming more important than the amount of knowledge they possess. Creativity is in particular important, for it creates innovation, sets challenges and is necessary to cope with increased competition (Saavedra & Opfer, 2012; Shaheen, 2010; Silva, 2009).

There is not one single definition available in the literature on creativity. Overall, three dimensions can be distinguished, being the actual achievement of creative performances, divergent thinking and a broader definition. Creativity as the actual achievement of creative performance, such as writing a novel or composing music, is often measured by self-reports in which participants have to indicate their creative achievements across different domains (Jauk, Benedek, Dunst, & Neubauer, 2013; Matud, Rodriquez, & Grande, 2007). Other studies measure creativity by the possibility to create new, original and/or multiple ideas or solutions, also called divergent thinking. Tests to measure this type of creativity use originality, fluency and/or flexibility as indicators of creative thinking (Jauk et al., 2013; Kim, 2005; Wang, 2012). Finally, Urban and Jellen (1996) developed the Test for Creative Thinking – Drawing Production (TCT-DP) to assess creativity by a more holistic definition, taking into account both divergent and quantitative, as well as qualitative aspects. They therefore included aspects such as construction and composition, but they also included other components they found in literature on creativity like risk taking, boundary breaking, unconventionality and humour (Urban, 2005).

Some research findings suggest that creativity is related to intelligence (Jauk et al., 2013; Nusbaum & Silvia, 2011; Wang, 2012). Nusbaum and Silvia (2011) for instance, found a significant relationship between creativity and intelligence ($R^2 = .20$), measuring creativity with a divergent thinking task. Urban (2005) however, found a correlation of zero between the TCT-DP and IQ. Differences between these studies may be explained by the subjective scoring of the divergent thinking task in the first study, and the relative homogeneous group that was assessed in the second. Either way, it seems that the relationship between intelligence and creativity depends on the concepts and measures that are used, divergent thinking being more related to intelligence than the broad concept of creativity measured with the TCT-DP.

This assumption is being confirmed by two recent meta-studies (Batey & Furnham, 2006; Kim, 2005). Batey and Furnham (2006) found studies with modest correlations. Remarkable was the way intelligence and creativity were defined in different studies, since divergent thinking tasks were in some studies used as a measure of creativity, whereas other studies used it as a criterion for intelligence. This study also points at a stronger correlation between IQ and creativity measured by fluency than by originality. In addition, Kim (2005) compared correlations found in 21 different studies and calculated a mean r of .174, a rather small positive correlation. Moreover, she found that different creativity tests significantly explained the variances in correlations. There was, for instance, a significant difference between a divergent thinking test presented as a game and a comparable test that was presented as a test. Therefore, the relationship between, but also the exact definitions and optimal measurements of intelligence and creativity are not yet clear.

The focus of this thesis is on creative skills of children with different types of ASD. Following the Diagnostic and Statistical Manual of Mental Disorders IV text revised ([DSM-IV-TR], American Psychiatric Association, 2000) the autism spectrum contains multiple disorders, the most prevailing being Autism, Asperger syndrome and Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS). Children with Autism experience qualitative dysfunctions in social interaction and communication, and show restrictive, repetitive and stereotype behaviour, interests and activities. The criteria for Asperger Syndrome are much the same, except lagging behind in language and cognitive development as well as the problems with adaptive behaviour and curiosity about the environment. Children with PDD-NOS show symptoms that look like autism and other developmental disorders, but do not meet the criteria. Because these criteria are very similar, the DSM-V combined them all in one disorder; Autism Disorder (Wicks-Nelson & Israel, 2013; Wing, Gould, & Gillberg, 2011).

There are various hypotheses about the relationship between intelligence and creativity in children with ASD. The general view is that children with ASD have a lack of imagination and therefore cannot be creative (Lyons & Fitzgerald, 2013). On the other hand, there are other characteristics of children with ASD that favour creativity, such as great determination, narrow interests, fascination for facts, their detailed look, and having savant skills (Liu, Shih, & Ma, 2010; Lyons & Fitzgerald, 2013). About 10-30% of the people diagnosed with ASD show savant skills; idiosyncratic and outstanding skills in one specific domain, like calendar calculating, memory and art (Pring, Ryder, Crane, & Hermelin, 2011).

Focusing on intelligence of children with ASD, it appears that autistic children show impairments in language and cognitive development (Wicks-Nelson & Israel, 2013; Wing et al., 2011). On the other hand, from a recent meta-analysis it appeared that these problems are not caused by impairments in logical reasoning, imagination and creativity (López Astorga, 2014). López Astorga (2014) concludes that people with autism have a different cognitive style, characterized by search for details and interest for minimal modifications. This can be useful in slowly executed and systematic procedures and this style is therefore not necessarily less effective than the average cognitive style (López Astorga, 2014). Nevertheless, it should be noted that every child is unique and that the characteristics of autism should never be generalized.

Little research has been done into the exact relationship between intelligence and creativity in children with ASD and findings differ. This again seems to depend on the type of research: what type of ASD has been investigated, and what definitions and tests were used (Craig & Baron-Cohen, 1999; Liu et al., 2010; Lyons & Fitzgerald, 2013)? However, it seems logical that the characteristic intelligence features of children with ASD, like attention for detail, extensive memory and information processing can lead to extraordinary creative skills.

In light of Inclusive Education, the drive to teach subjects that trigger creativity and other 21st century skills at every educational level has grown (McComas, 2014; Shaheen, 2010; Silva, 2009). This study will investigate the relationship between intelligence and creativity in children with ASD. The objective is to investigate whether or not the level of creativity of children with ASD is positively related to intelligence and whether children with ASD differ in their levels of creativity from children without ASD. More insight into this relationship could help increase the focus on abilities and talents of children with ASD instead of approaching autism as a disability. It could also provide more insight in the possible differences between different types of ASD, since the DSM-V recently combined them as one disorder. Science, arts and education could make better use of specific characteristics of people with ASD to include more of them in regular education and eradicate discrimination.

Method

Participants

Two different groups of children were approached to participate in this research. For the group of children with ASD, two schools for special education in Heerlen (Netherlands) were contacted to supply participants for this study. The participating schools selected children who were eligible for this study. Parents or caregivers from 64 pupils with ASD received a permission letter. Among them, 85.9% replied and finally the results of 55 children were analysed for the group of children with ASD. The average age of the children of this group was 9.73 years, ranging from 7.62 to 11.67 years. Only 12.7% of the participants in this group was female. Furthermore, the children in this group were diagnosed as having different disorders within the Autism Spectrum; Autism (47.3%), Asperger (5.5%) and Pervasive Developmental Disorder – Not Otherwise Specified (40.0%). For 7.3% of this group, the exact diagnose was not stated by their caregivers.

For the second group, 11 regular schools in Amersfoort (Netherlands) were contacted to join in a broader study by the University of Utrecht. Parents of 337 students in the fourth grade received a permission letter of which 80.12% replied. Therefore, 270 children took the four tests needed for this research. For this specific study however, typically developing children were selected by quota sampling, taking into account their total percentage score on the two intelligence tests and their age to create two comparable groups (see Table 1). From the different categories on intelligence score and age, 55 children were selected by systematic sampling (Neuman, 2014).

Table 1. *Descriptive Statistics of the Total Percentage scores on the NIO, age and gender of Children With and Without ASD*

	n	% score NIO		Age		% female
		M	SD	M	SD	
Children with ASD	55	.801	.275	9.73	.953	12.7
Children without ASD	55	.833	.207	9.89	.452	25.5

Conceptual definitions and measuring instruments

Intelligence. In this study, two types of intelligence have been tested; visual spatial intelligence and verbal reasoning. Hegarty (2010) states that visual spatial intelligence consists of two components; being able to make a flexible choice between mental imagination or a more analytic way of thinking, and being able to make a meta-representation to choose the optimal representation. Verbal reasoning is characterized by understanding and defining words (Berninger & Abbott, 2013).

The two types of intelligence of the participating children were measured by two subtests of the Nederlandse Intelligentietest voor Onderwijsniveau ([NIO], Dutch Intelligence test for Educational level, Van Dijk & Tellegen, 2004), namely the visual spatial test and verbal reasoning test. With the visual spatial test (NIO 1), children were given a two-dimensional representation of a three-dimensional figure. The children had to indicate with which foldouts the figure could be completed (see Figure 1). In the verbal reasoning test (NIO 2), two words at a time were given for which the children had to indicate how they were

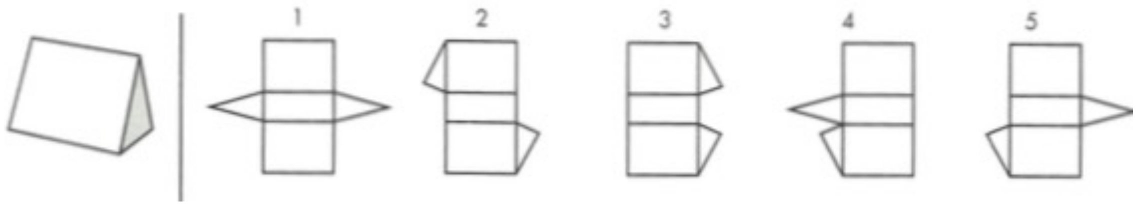

Figure 1. Example of one of the tasks on the visual spatial test (NIO 1). Adapted from “Handleiding NIO [Manual of the NIO],” by H. van Dijk and P. J. Tellegen, Amsterdam: Boom test uitgevers. Copyright 2004 by Boom Test Uitgevers.

related. The Commission Testaffairs Netherlands (COTAN) assessed the reliability of the NIO as a whole, as good (α = .95). The different subtests were also assessed as good, with an average score of .84. The criterion validity of the test varied from .69 to .79. The construct validity was rated as good (Van Dijk & Tellegen, 2004).

Creativity. As stated before, creativity contains many components. For this study a two definitions of creativity have been used, including divergent thinking, measured by fluency, flexibility and originality, as well as the more holistic definition of Urban and Jellen (1996), measuring also risk taking, boundary breaking, affection, unconventionality and humour (Urban, 2005).

To measure these two types of creativity of the participants, two tests were conducted, namely the Test for Creative Thinking – Drawing Production ([TCT-DP], Urban & Jellen, 1996), and the Mathematical Creativity Test ([MCT], Kattou, Kontoyianni, Pitta-Pantazi, & Christou, 2013). In the TCT-DP children were asked to complete a drawing which showed six figures that had different shapes, designs and positions (see Figure 2). The results were scored on fourteen different aspects, such as continuation, completion and connection of the figures. The inter-rater reliability is mostly found to be above r=.87. The parallel test reliability varies between .62 and .70 (Urban, 2005).

The second test to measure creativity in this research, was the MCT, a test assessing creativity skills in solving mathematical problems. The test consists of five mathematical questions and the children were asked to give multiple solutions (see Figure 3). The answers of the participants were scored with a ratio by taking into account fluency, flexibility and originality of the correct solutions. The internal consistency was valued as moderate (α = .78; Kattou et al., 2013).

Procedure

The four different tests were conducted for each class consisting of 5 to 32 children in their classrooms. Children in the class whose parents didn't give permission, were given another task by their teacher. The children started with the two NIO tests, followed by the MCT and finished with the TCT-DP. Together with the teacher, the researcher decided whether the children still had enough energy and focus to continue. Sometimes a break was necessary for the children to relax and to help the children focus again. Conducting the tests took two hours on average.

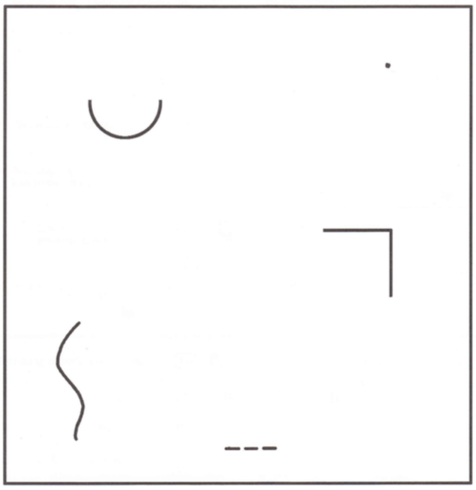

Figure 2. The TCT-DP. Children were asked to complete this unfinished painting in whatever way they liked. Adapted from "Test for Creative Thinking – Drawing Production (TCT-DP)," by K. K. Urban and H. G. Jellen, 1996, Lisse: Swets and Zeiltinger. Copyright 2011 by Pearson Assessment & Information GmbH, Frankfurt/Main.

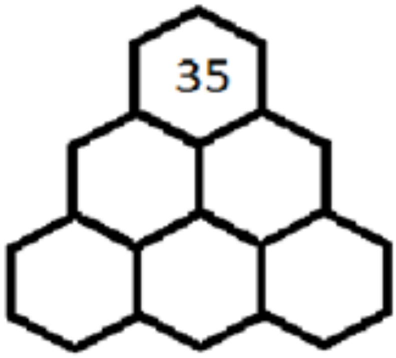

Figure 3. Example of one of the tasks on the MCT. Children were asked to give as many solutions as possible to complete this figure by using multiple calculations for each figure (+, -, :, x). Adapted from "Connecting mathematical creativity to mathematical ability," by M. Kattou, K. Kontoyianni, D. Pitta-Pantazi and C. Christou, 2013, ZDM Mathematics Education, 45, p. 172. Copyright 2012 by KIZ Karlsruhe.

Analyses

The data analytic computer program Statistical Package for the Social Sciences was used to analyse the results of the four tests of the two groups. Prior to the analyses, the assumptions for a Pearson test and an ANCOVA were ascertained by the Shapiro-Wilk test, histograms and scatterplots for normality and linearity, an interaction test for homogeneity of regression slopes and the Levene's test for homogeneity of variances.

Results

After selecting 55 children without ASD, the assumption of normality proved to be violated for the total percentage score on the NIO in the sample (see Table 3). Therefore, the Mann-Whitney *U* Test was used to confirm that there was no significant difference on total percentage score on the NIO between the children without ASD (*Mean Rank* = 60.25, $n = 55$) and with ASD (*Mean Rank* = 50.75, $n = 55$), $U = 1251.00$, $z = -1.56$ (corrected for ties), $p = .118$, two-tailed. Also, no significant difference in age was found between the non-ASD group ($M = 9.89$, $SD = 0.45$) and the ASD group ($M = 9.73$, $SD = .95$), $t = 1.18$, $df = 77.16$, $p = .240$ (equal variances not assumed). The difference in gender between the two groups has been neglected, with 25.5% being female in the typically developing group and 12.7% in the group with ASD.

Table 2. *Number of participants, Mean scores and Standard Deviations of Children without ASD and Children with different types of ASD on NIO 1, NIO 2, the TCT-DP and the MCT*

	n	NIO 1	NIO2	TCT-DP	MCT
non-ASD	55	22.87 (4.82)	7.84 (4.04)	22.18 (8.79)	4.67 (2.09)
ASD	55	23.05 (5.94)	6.75 (5.50)	21.95 (10.03)	4.62 (1.75)
- Autism	*26*	21.12 (5.11)	6.38 (5.08)	22.73 (8.27)	4.47 (1.66)
- Asperger	*3*	28.33 (4.04)	12.00 (8.19)	38.67 (19.30)	4.36 (1.41)
- PDD-NOS	*22*	24.32 (6.01)	6.68 (5.96)	19.27 (9.31)	4.91 (1.77)
- unknown	4	24.75 (8.81)	5.50 (2.08)	19.00 (6.06)	4.15 (2.79)

The Shapiro-Wilk test, assessed prior to the analysis for correlation, indicated that the assumption of normality was violated for the NIO 2 scores and TCT-DP scores of children with ASD (see Table 3). Therefore, a Spearman's Rho was conducted to test the hypothesis that intelligence and creativity are positively correlated for children with ASD. The correlations for the two independent NIO's with the different creativity tests were assessed in this analysis. This indicated no significant correlation between NIO 1 and the TCT-DP. By contrast, a small positive correlation was found between NIO 2 and the TCT-DP, and a medium positive correlation was found between the MCT and both NIO 1, as well as NIO 2 (see Table 4).

In addition, for the group of typically developing children, a Spearman's Rho was conducted to examine the same correlations, for the assumption of normality was also here violated (see Table 3). This indicated no significant correlation between both NIO's and the TCT-DP. Also, no significant correlation was found between NIO 1 and the MCT. The only correlation that turned out to be significant, was the small to medium positive correlation between NIO 2 and the MCT (see Table 4).

The Fisher r-to-z transformation was conducted to compare the correlations between the percentage score on the NIO, as well as both NIO's individually with the different creativity tests of the two groups. Non of the correlations for the group of children with ASD appeared to be significantly higher than for the group of typically developing children (see Table 4).

Second, the hypothesis whether or not children with ASD score differently on creativity tests than typically developing children was assessed. A one-way analysis of covariance (ANCOVA) was conducted to compare the scores on the MCT. To partial out the

Table 3. *Scores of the Shapiro-Wilk Test to check for normality in the total sample, sample of children with ASD and sample of children without ASD*

	Total sample	Children with ASD	Children without ASD
(Sub)tests	*W*	*W*	*W*
NIO 1	.960**	.961	.944*
NIO 2	.914*	.850**	.951*
TCT-DP	.979	.953*	.977
Continuations	.720**	.787**	.677**
Completions	.830**	.882**	.748**
New elements	.860**	.863**	.853**
Connections with lines	.872**	.858**	.851**
Connections in addition to theme	.749**	.752**	.739**
Boundary breaking (dependently)	.360**	.284**	.424**
Boundary breaking (independently)	.553**	.576**	.530**
Perspective	.234**	-	.364**
Humour	.679**	.690**	.669**
Unconventional manipulation	.342**	.286**	.392**
Abstract/surrealistic elements	.563**	.570**	.557**
Unconventional combinations	.609**	.543**	.643**
Unconventional use of figures	.827**	.776**	.857**
MCT	.980	.994	.951*
MCT-A	.852**	.954*	.826**
MCT-B	.978	.989	.942*
MCT-C	.981	.989	.956*

Note. *significant at $p < .05$. **significant at $p < .01$.

The Shapiro-Wilk Test was not conducted for the aspect Perspective of children with ASD due to zero points of these children on this aspect.

Table 4. *Correlations Between Both NIO Scores and Different Creativity Tests for Children With and Without ASD*

	Children with ASD		Children without ASD			
	r_s	p	r_s	p	z	p
			NIO 1			
TCT-DP	.211	.061	.024	.431	.97	.166
MCT	.341	.005	.083	.273	1.39	.082
			NIO 2			
TCT-DP	.251	.032	.194	.078	.31	.378
MCT	.444	<.001	.286	.017	.93	.176

Note. Results of a one-tailed test.

z = z-score on the Fisher r-to-z transformation.

Table 5. *Scores on the ANCOVA's for Differences Between Children With and Without ASD and Differences Between Different Types of ASD on the MCT, Controlling for the NIO 2*

	F	p	partial η^2
With or Without ASD	0.19	.667	.002
Different types of ASD	1.31	.868	.073

effects of the NIO 2 scores for both groups, as the Spearman's Rho stated, the NIO 2 was included as a covariate. The ANCOVA revealed that, after controlling for the influence the NIO 2, there was no significant difference in the MCT score between children with and without ASD (see Table 5).

The scores on the TCT-DP of children with and without ASD were compared with the Mann-Whitney *U* Test, for the TCT-DP scores of children with ASD were not normally distributed (see Table 3), and there was no significant correlation found between the TCT-DP and both NIO's. This indicated that children without ASD (*Mean Rank* = 57.02, n = 55) did not significantly differ from children with ASD (*Mean Rank* = 53.98, n = 55), U = 1429.00, z = -.500 (corrected for ties), p = .118, two-tailed.

Although, no significant difference was found between the two groups on the TCT-DP, the descriptive statistics seemed to point at differences in the different aspects. So the Mann-Whitney *U* Test was used to test whether or not these differences were significant,

Table 6. *Mean Scores and Standard Deviations of Children With and Without ASD on the significantly differing aspects of the TCT-DP, and the Mann-Whitney U Test*

	Children without ASD	Children with ASD	
	M (*SD*)	*M* (*SD*)	*z*
Completions	4.45 (1.14)	3.69 (1.39)	-3.36**
Connections with lines	1.82 (1.89)	3.62 (2.22)	-4.14**
Perspective	0.15 (.45)	0.00	-2.51*
Unconventional combinations	1.35 (1.49)	0.76 (1.32)	-2.13*
Unconventional use of figures	1.51 (1.10)	1.02 (1.16)	-2.29*

Note. *significant at $p < .05$. **significant at $p < .01$.

because most of the scores on the aspects were not normally distributed (see Table 3). This revealed a significant difference between the two groups on five of the aspects of the TCT-DP, with children without ASD scoring higher on Completions, Perspective, Unconventional combinations of symbols and figures, and Unconventional use of given figures. Children with ASD scored higher on Connections with lines (see Table 6).

Even though the groups of children with different types of ASD were very small, the scores on the tests of children with different types of ASD were also compared to see if they were significantly different. First, the ANCOVA indicated that, after controlling for the effect of NIO 2, there was no significant difference in MCT score between children with different types of ASD (see Table 5).

Furthermore, an Analyses of Variance (ANOVA) was conducted to find out if they significantly differed on the other tests. Only three (sub)tests appeared to be normally distributed (see Table 3). Nonetheless, the ANOVA was conducted, because it should be robust over moderate violations (Allen & Bennet, 2012). This revealed that the scores on the TCT-DP were significantly different, in which the aspects Fragments that are dependently boundary breaking, Fragments that are independently boundary breaking, and Unconventional combinations of symbols and figures additionally turned out to be significantly different (see Table 7). Post-hoc testing revealed that children with an Asperger diagnosis scored higher on those aspects than children with other ASD diagnoses.

Table 7. *Mean scores and Standard Deviations of Children with different types of ASD on the significantly differing aspects of the TCT-DP and the outcome of the ANOVA*

	Autism	Asperger	PDD-NOS	Unknown	*F*
Total TCT-DP	22.73 (8.27)	38.67 (19.30)	19.27 (9.31)	19.00 (6.06)	4.06*
Boundary breaking (dependently)	.00	3.00 (3.00)	.41 (1.40)	.00	7.11**
Boundary breaking (independently)	1.15 (1.91)	4.00 (3.46)	.68 (1.59)	.00	3.41*
Unconventional combinations	.58 (1.21)	.00	.68 (1.29)	.75 (1.50)	3.51*

Note. *significant at $p < .05$. **significant at $p < .01$.

Discussion

To include more children with ASD in regular education, it is important to focus on their talents and possibilities rather than on their disabilities. While our 21st century society asks for certain skills, focus on those skills, such as creativity, in education, science and arts could be a way to increase inclusion and make more use of the talents of children with ASD. Therefore, this research tried to provide greater clarity in the relationship between creativity and intelligence in children with ASD and possible differences with typically developing children.

Primarily, for children with ASD, a medium positive correlation between both NIO's and the MCT was found, while a small positive correlation was found between only NIO 2 and the TCT-DP. For typically developing children, only a small to medium positive correlation was found between NIO 2 and the MCT. Nevertheless, these correlations were not significantly different than the ones found in the sample of children without ASD. Taking everything into account, it may be stated that there is a relationship between intelligence and divergent thinking in children with ASD as well as children without ASD, but that there is no correlation, or only a small one, between intelligence and the more holistic definition of creativity.

These findings are in line with the study of Nusbaum and Silvia (2011), although they found a stronger correlation between divergent thinking and intelligence. Urban (2005) did not find a correlation between intelligence and creativity measured by the more holistic definition, whereas in this study a small correlation was found between visual spatial intelligence and creativity for the children with ASD. The different correlations found in this study may be explained by the smaller sample. Also, the way intelligence is measured should be taken into account, for the NIO is a test intended for children being on average two years older than the children in this study. This could have influenced the NIO scores, although in the Netherlands, it is the only quick way to test intelligence for large groups. Also, these results point out that more research should be done into the definitions of both intelligence and creativity. Is divergent thinking part of intelligence or creativity, or is it a skill for which both intelligence and creativity are needed?

Furthermore, the findings of this study are in contrast with the view that children with ASD cannot be creative (Craig & Baron-Cohen, 1999; Lyons & Fitzgerald, 2013). Children with ASD appear not to differ from children without ASD in creativity, therefore not being more creative than others either, while typical characteristics of ASD, like savant skills and a detailed look, would suggest so (Liu et al., 2010). This could be explained by other characteristics of children with ASD that do not favour creativity, like deficits in imagination (Craig & Baron-Cohen, 1999).

Nevertheless, it appears that children with ASD show a different profile in creative skills than typically developing children. On average, they scored lower on a number of aspects of the TCT-DP, like Perspective. On the other hand, they scored higher on Connections with lines. This points out that children with ASD show a different profile on creative skills. To facilitate the inclusion of these children in regular education, professionals should bear this in mind and focus on the different talents of every individual child.

Although the groups were very small and the variances between the scores were quite large, it seems that children diagnosed with different types of ASD also show a different creative skills profile. The three children with Asperger in this study scored higher than other children with ASD on the TCT-DP. This could be explained by the fact that children with an Asperger diagnosis often show more curiosity about the environment than children with other types of ASD (Wing et al., 2011). The recent choice of the American Psychiatric Association to combine all the different types in one disorder might therefore be challenged. More research into ASD and possible differences between children with the classification, should give more clarification into the characteristics of ASD, not only focussing on their deficits, but more on their strengths. Therefore, this is the message to both education, science and arts, as well as psychologists and orthopedagogues when dealing with children with ASD; focus on their individual talents.

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