

Output 7  
Master's Thesis

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The difference of the level of divergent thinking between four-year-old boys and girls

Master's thesis  
Utrecht University  
Master's programme in Clinical Child, Family and Education Studies  
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Date: May 25, 2017



## Preface

Hoenderloo, May 2017

Before you lies my master thesis, the result of a study into the gender differences in divergent thinking among four year old children. With this thesis, I will (hopefully) finish the master Clinical Child, Family and Education studies. This master thesis and the related research, in combination with my previously attained bachelor of Education, has provided me with the opportunity to combine my knowledge and interest in the field of education, teaching, behavior and development.

I would like to use this opportunity to thank several people, without which this thesis would not have been possible. First, my thesis supervisor, Honghong Bai, for her critical and scientific vision and her feedback which allowed me to continuously move forward. Thanks go to Claire Garandau for her role as my second reviewer. The participating primary schools and the children. Without their cooperation, this study would not have been possible. Merel, my partner in crime, during the past year through all the fun times, hardships, stressful moments and challenges, without you I wouldn't be where I am today.

In addition, I would like to thank my friends for their patience, involvement and providing fun moments of (much needed) relaxation. And of course, my family; my brother for his down-to-earth demeanor, scientific vision and support. My sister for her encouragements, experience and for always being there to talk to. My brother-in-law for his knowledge of SPSS and statistics, as well as his continuous support. And finally, some special thanks go to my parents for their unconditional support, love and patience, particularly during those 'rare' stressful moments. For each of you, I'm truly grateful!

- Lotte de Leeuw

*“Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand.”*

*-Albert Einstein*

**Abstract**

For many years, divergent thinking has been an intriguing subject for scientific research. Research on divergent thinking among children provides insight into multiple research areas, such as developmental psychology, the development of creativity, and education. Despite the importance of research on divergent thinking among children, little is known. Additional, and more specific research, is therefore required.

This research is an explorative study to gain insight into the differences of divergent thinking between boys and girls at the age of four. For this study, divergent thinking is seen as the ability to interpret multiple problems and construct appropriate solutions (Kaufman & Beghetto, 2009, Runco, 2004; Runco & Okuda, 1988).

To obtain results from 105 four-year-old boys and girls (56), from four different primary schools in the Netherlands, the study used the Torrance Test of Creative Thinking, figural version (TTCT). Using this test, divergent thinking is measured and compared on the domains of fluency, originality, and elaboration. Using a multivariate analyze of variance (MANOVA), a significant difference was found on elaboration, with girls outperforming boys. No significant difference was found on fluency and originality.

A possible conclusion for the obtained results can be explained by socialization differences between the genders, what possibly results in different creative performance styles of boys and girls. Valuable information may be obtained by studying these creative performance styles of genders. Additionally, this research only conducted figural divergent thinking tests, to obtain a more complete representation of the differences and the similarities of the genders, research specified on both figurative and verbal measured divergent thinking tests is recommended.

*Keywords:* divergent thinking, gender differences, four-year olds, preschoolers, TTCT-test.

### **Samenvatting**

Voor vele jaren is divergent denken een intrigerend onderwerp voor wetenschappelijk onderzoek. Onderzoek naar divergent denken bij kinderen biedt inzicht in uiteenlopende onderzoeksgebieden, zoals ontwikkelingspsychologie, creativiteitsontwikkeling en onderwijskundig gebied. Ondanks het belang van onderzoek naar de ontwikkeling van het divergent denken bij kinderen, is er weinig bekend. Om meer inzicht te verkrijgen in het niveau en de ontwikkeling van divergent denken van jonge kinderen is meer en specifiek onderzoek noodzakelijk.

Dit onderzoek betreft een exploratieve studie, om meer inzicht te verkrijgen in sekseverschillen in het divergent denken bij vierjarige. In deze studie wordt divergent denken gezien als het vermogen om voor meerdere problemen, verscheidene passende oplossingen te kunnen bedenken (Kaufman & Beghetto, 2009, Runco, 2004; Runco & Okuda, 1988).

Voor het verkrijgen van resultaten, van 105 vierjarige jongen en meisjes (56), vanuit vier verschillende basisscholen in Nederland, is gebruik gemaakt van de Torrance Test of Creative Thinking (TTCT), figuurlijke versie. Met gebruik van deze test, wordt divergent denken gemeten en vergeleken aan de hand van de domeinen, fluency, originaliteit en elaboration. Met behulp van een multivariate variantieanalyse (MANOVA), is een significant verschil gevonden voor elaboration, waar meisjes hoger scoren dan jongens. Geen significant verschil is gevonden voor fluency en originaliteit.

De gevonden resultaten kunnen mogelijk verklaard worden door verschillen in socialisatie tussen jongens en meisjes. Dit kan op diens beurt verschil opleveren in de uiting van creatieve stijlen tussen de seksen. Waardevolle informatie kan mogelijk verzameld worden bij aanvullend onderzoek naar deze stijlen. Daarnaast zijn in dit onderzoek alleen figuratieve taken gebruikt. Voor een completere representatie van de verschillen en overeenkomsten tussen de seksen, wordt specifiek onderzoek met zowel de figuratieve als verbale divergent denken testen aangeraden.

*Kernwoorden:* divergent denken, sekseverschillen, kleuters, vier-jaar, TTCT-test.

## **Introduction**

### **Creativity and divergent thinking**

Thinking ‘out of the box’ and ‘use your creativity’, these phrases are familiar to many of us, but what do they exactly mean? Do they refer to the capability of creative thinking or do they just mean to create new possibilities? These are some questions that catches people’s eyes. In literatures, the creative process which needs to formulate multiple ideas and/or problems is seen as divergent thinking (Runco & Okuda, 1988).

A clear definition of divergent thinking has been proven difficult to establish, which results in a wide range of definitions (Kaufman & Beghetto, 2009, Runco, 2004). In general, divergent thinking is seen as the ability to interpret a variety of issues and construct fitting solutions to these problems (Guilford, 1957; Runco & Albert, 1986). It is often used as a predictor for a creative result (Gilhooly, Fioratou, Anthony & Wynn, 2007, Beghetto & Kaufman, 2007; Runco & Jaeger, 2012, Ruco & Acar, 2012). Robinson (as cited in Aljughaiman & Mowrer-Reynolds, 2005) thinks that divergent thinking is a mandatory skill to be creative.

### **Research of gender differences in divergent thinking**

As stated by Vygotsky: “one of the most important questions of child psychology and pedagogy is the question about creativity in children, its development and its significance for the general development of the child” (in Glăveanu, 2011). Divergent thinking, as a core process of creativity, has been an intriguing subject for scientific studies for many years (Runco, 2004). Research into divergent thinking in children provides insight for a wide range of areas, such as child and developmental psychology, creative research and educational practises (Glăveanu, 2011). However, despite the acknowledgement of the importance of children’s creativity, little is known (Feldhusen, 2002; Furnham, 2006).

Research into the gender differences in divergent thinking has been proven in recent years to be a controversial and disputed subject (Sayed & Mohamed, 2013). In contrast to the general acceptance and importance of divergent thinking, Baer and Kaufman (2006) state that gender, regarding creativity is not yet considered as an important factor. Studies that do look at divergent thinking between the genders, found no consistent results (Sayed & Mohamed, 2013).

He and Wong (2011) studied creativity in 985 school children (499 boys) using the Test for Creative Thinking-Drawing Production (TCT-DP). They found that both genders have their strengths and limitations. Boys scored higher on boundary-breaking thinking, while girls scored higher on thoroughness of thinking. Zachopoulou and Makri (2005) studied 191 preschool and elementary school children using the divergent Movement Ability Test. They found that gender

is not a contributing factor to the level of divergent thinking. Boys scored a bit higher on motor flexibility, whereas girls scored a little higher on motor fluency.

However, some other studies found a higher result on divergent thinking for women compared to men (Singh in Baer & Kaufman, 2006; Jaquish & Ripple, 1980; Kershner & Ledger, 1985). Jaquish and Ripple (1980) used an adaptation of Cunningham and Torrance's sounds and images to determine the level of divergent thinking. This test records the spontaneous reactions following a divergent thinking assignment. They found that female adolescents scored higher on the relation between divergent thinking and self-esteem.

In both studies of Torrance and Aliotti (1969) and Kershner and Ledger (1985) the Torrance Test of Creative Thinking was used to measure the level of divergent thinking. They both used the subtests fluency, flexibility, originality and elaboration among children aged 9-11 years. Torrance and Aliotti (1969) tested 118 children (59 boys). Boys scored higher on flexibility and originality, whereas girls outperform boys on elaboration. There were no results given for the scores on the level of fluency. In the study of Kershner and Ledger (1985) no significant results were found between the genders.

### **The importance of research among preschoolers**

The epicenter of creativity, spatial and abstract thinking is found in the right part of the brain. In this part, associative thinking (A is connected to B and C), establishing connections ('this is related to this'), formulating multiple solutions for a single problem (Brizendine, 2010) the ability to observe ('I see this, but someone else might see this') and the ability to see possibilities all develop (Snijders, 2016). This part develops both earlier and faster among boys. In addition, when it comes to playing games and drawing pictures, girls appear to be more caring whilst boys focus more on the object itself (Kimura, 1992; Swaab, 2007).

### **Gaps and limitations in existing literatures**

Most research is conducted with men and women, or older children and young adults (eleven years and up). Little research is done with young children (preschool) (Baer & Kaufman, 2006). This may be explained by the development of divergent thinking, which, according to Piaget (1962), only develops in the pre-operational phase (2 to 6-7 years of age). Where divergent thinking is only visibly displayed in the orientation and research phase of the child (Piaget, 1962).

### **The current study**

This study will focus specifically on the possible differences of divergent thinking between young boys and girls (aged four). The collected data and the conclusions of this study are expected to offer insight in the level of divergent thinking of young children. Possibly this

information can be used for further research on the topic of divergent thinking and the possible differences between genders. Next to that, it may assist in the way children are receiving education based on their age and gender. This may improve the current curriculum for boys and girls. Finally, it may also contribute to the exploration of the creative thinking process and the behaviour of children (Craft, 2005) and the development of better qualities and skills for each individual (Glăveanu, 2011).

The varying results of the studies into gender differences in terms of divergent thinking provide no conclusive way to formulate a proper hypothesis. Considering the research method (drawing, adding patterns/shapes) and from practical experience, this research will be an explorative study, focusing on examining the gender differences of divergent thinking of four-year old children.

### Method

#### Participants

Different schools throughout the country (The Netherlands) have been approached to participate in the study. The total number of schools approached is over 20. If schools (e.g. teachers or principals) showed interest, e-mails with information and expectations regarding the project were sent. Once schools agreed to participate, they were required to provide forms of consent to the parents and/or legal guardians of the children. Children without a signed consent form were excluded from this study. From the approached schools, 4 decided to participate in the study. The participants included both boys and girls of age four and were all part of group one in their respective schools. Descriptive statistics (mean and age) are presented in table 1.

Table 1.

*Descriptive statistics for the participants, boys and girls and age*

	Boys	Girls	Total
<i>N</i>	49	56	105
<i>M (age)</i>	4.41	4.46	4.44
<i>SD</i>	.240	.323	.501
<i>%</i>	47	53	100

### **Instruments**

Divergent thinking is measured by Torrance Test of Creative Thinking (TTCT), figural version (Torrance, Ball & Safter, 2008). The TTCT is designed by Paul Torrance in 1966 and is the most commonly used test to measure creativity (Davis, 1997). Treffinger (1985) states that the TTCT test is a reliable method for scientific purposes. For this study three measures, fluency, originality and elaboration, are used to evaluate divergent thinking (Torrance, 1968).

### **Procedure**

The tests are conducted at the participating primary schools in October and November 2016. This study is part of a larger research project in which a second round of data collection took place in April 2017. The instruction of the TTCT-test is adapted (shortened) because of the age and language capability of the children (Feldman, 2009). The first task that is used of the TTCT-test, is the Picture Construction activity. The child receives a paper with a curved shape drawn on it. The child is required to draw a picture or object containing the curved shape. The second task is the Picture Completion activity. This task consists of ten incomplete figures where the child is asked to complete the figures by adding lines, creating new objects or pictures. The final task is called the Lines activity. This activity consists of three pages containing sets of parallel lines. The child is asked to make as many objects or pictures using the pairs of straight lines within ten minutes.

The scoring of the test components is based on the test manual. Fluency and originality are assessed by means of 1 or 0 points. For fluency one point is given when there is a meaningful relation between the drawing and the stimulus. For originality one point is rewarded for the specific use of the stimulus, based on the statistical infrequency and unusualness of the response. For example, one point is rewarded if the stimulus is made in to a pair of lips, but if it's made in to a face, zero points are rewarded. For elaboration 1 point is rewarded for adding decoration, color, deliberate shading, each major variation of the design, each elaboration in the title beyond the labelling level and each essential detail of the total response. Using the test manual for scoring the test components makes the generalization to other research, comparative and complementary, more reliable and explicit.

**Fluency.** The output of a wide range of ideas or alternate solutions to a problem is also indicated by the term fluency. It implies understanding instead of just remembering learned information (Torrance, 1979). The fluency score in the TTCT-test is submitted by the total number of ideas a child expresses through interpretable responses that use the stimulus in a significant way (Torrance, 2008).



**Originality.** Ideas that are one-of a kind or uncommon imply the creation of original ideas, also seen as originality. Also, combining existing information on a topic to formulate a new idea (Torrance, 1979). The scoring of originality in the TTCT-test is based on the statistical infrequency and unusualness of the response. Given responses that are present on the exclusion list associated with this activity are eliminated, this will result in a total score of originality (Torrance, 2008).

**Elaboration.** The development of improving ideas by adding more detail is specified as elaboration. Interest in the subject as well as understanding of the subject is improved by adding detail and clarity to the initial idea (Torrance, 1979). Within the TTCT-test elaboration is scored (for the figural test) with two assumptions. The first assumption states that the minimum and primary response to the stimulus figure must be one answer. The second assumption concerns the scoring of elaboration, imagination and exposition of detail must be a function of creative ability (Torrance, 2008).

## Results

### Data analysis

A multivariate analysis of variance (MANOVA) was used to examine the gender difference of divergent thinking between four-year-old boys and girls ( $N = 105$ ). Three dimensions: fluency, originality, and elaboration were included in the model as dependent variables, and gender was included as the independent variable. For all analyses an alpha level of .05 is used.

Before conducting the MANOVA the data were examined using SPSS Statistics to ensure all its underlying assumptions were met (Allen, Bennett & Heritage, 2014; Field, 2014).

Univariate normality was assessed with Shapiro-Wilk tests, some variables were significant (fluency boys  $p = .004$ , and elaboration girls  $p = .000$  and boys  $p = .000$ ), which indicates that the assumption is not met. However, the Q-Q plots showed that the groups are equally skewed and the boxplots are roughly symmetrical, so the assumptions could be assumed. Additionally, no multivariate outliers were found in the data, supporting the assumption for multivariate normality.

Correlations between the dependent variables were not excessive (Flu-Org =  $r = .86$ ,  $p = .000$ , Flu-Elab =  $r = .66$ ,  $p = .000$ , Org-Elab =  $r = .60$ ,  $p = .000$ ), the maximum Mahalanobis Distance was 13.638, where the critical  $\chi^2$  value for  $df = 3$  at  $\alpha = .001$  is 16.266 indicating that multicollinearity was not of concern.

Furthermore, the scatterplots show that the relationship between the dependent variables were roughly linear. Finally, Box'  $M$  was 4.486, which is non-significant at  $\alpha = .001$ , indicating that homogeneity of variance-covariance matrices could be assumed.

As all the underlying assumptions were supported by the data, a MANOVA was conducted. The results showed that there was a significant difference of gender (girls vs boys) on the combined dependent variables (fluency, originality and elaboration),  $F(3, 101) = 4.76$ ,  $p = .004$ , partial  $\eta^2 = .124$ .

Furthermore, ANOVA Analysis was further conducted to examine the differences on each dependent variable. The results showed no significant effects for fluency ( $F(1,103) = 2,11$ ,  $p = .150$ , partial  $\eta^2 = .020$ ) and originality ( $F(1,103) = .002$ ,  $p = .969$ , partial  $\eta^2 = .000$ ) variables. However, the elaboration was statistically significant  $F(1,103) = 6,45$ ,  $p = .013$ , partial  $\eta^2 = .059$ . Girls who participated in the Torrance Test of Creative Thinking show significantly higher elaboration ( $M = 11,95$ ) than boys ( $M = 7,08$ ). Group means and standard deviations for each dependent variable are presented in table 3.

Table 2.

*Descriptive Statistics for Girls (n = 56) and Boys (n = 49) on Each Dependent Variable*

Dependent Variable	Gender	$M$	$SD$
Fluency	Girls	11.84	0.94
	Boys	9.84	1.01
Originality	Girls	8.70	0.76
	Boys	8.65	0.81
Elaboration	Girls	11.95	1.31
	Boys	7.08	1.40

### Discussion and conclusion

This explorative study examined the possible differences of four-year old boys and girls on the level of divergent thinking. This level is measured with three domains, fluency, originality and elaboration (Torrance, 1968) of the Torrance Test of Creative Thinking (TTCT), figural version (Torrance, Ball & Safter, 2008). Subsequently a multivariate analysis of variance (MANOVA) is used on the data to obtain the recent results.

## DIVERGENT THINKING, GENDER DIFFERENCES, PRE-SCHOOLERS

The results show that the domains of fluency and originality have no significant differences between boys and girls. The variable elaboration, however, did show a significant difference. The girls who participated in the TTCT test scored significantly higher on the elaboration component than participating boys.

Previous studies have shown no consistent results on the gender difference of divergent thinking (Sayed & Mohamed, 2013). In addition, little research has been done on young children. Most research has been conducted among men and women, or older children and adolescents (Baer & Kaufman, 2006). Therefore, it is difficult to make a clear and direct comparison between current and previous research. The lack of research among preschoolers can be explained by the development of divergent thinking during the pre-operational phase (2 to 6-7 years of age) and the expression that is mostly measurable in the orientation and research phase (Piaget, 1962).

Nevertheless, the significantly higher score of girls in relation to boys on the component elaboration can be explained by the more caring nature of girls in playing games and drawing. Where boys, in comparison, are more focused on the object itself (Kimura, 1992; Swaab, 2007). This can be explained by the natural difference between boys and girls, where boys are more active in daily physical activities and girls more think before they act, which results in a higher variety of motor responses.

The collected information and results of this study can contribute to new knowledge and insight into the development of divergent thinking and behavior in young children (Craft, 2005). Furthermore, it can make a valuable contribution to adjustments to the curriculum for boys and girls, which in turn could help in further developing specific qualities and skills (Glăveanu, 2011).

The differences between the participating schools in this study may have influenced the obtained results. Differences are observed in the form of education, the class and group sizes and the subjects of education itself. Besides this, the different socialization between boys and girls might have also affected the results. Where girls tend to assimilate when they encounter new information, boys show more desire to accommodate themselves. Block (1984) states that both assimilation and accommodation can be used creatively. Based on these socialization differences between boys and girls, as well from observations during the test recordings, it might be interesting for future research to look at the differences in creative performance styles according to the genders (Hargreaves, 1977). This might give an explanation or clarification as well as insight in the possible differences or similarities between the genders in the measured domains of the divergent thinking test. For example, in this research, the domain of elaboration,

## DIVERGENT THINKING, GENDER DIFFERENCES, PRE-SCHOOLERS

where girls outscore boys. Can this be explained by their creative performance styles or is this more caused by the possible different socializations of girls and boys.

In addition, the current study has only focused on the gender differences in figurative measured divergent thinking tests. To obtain a more complete representation of the level of divergent thinking of boys and girls, it is also recommended to invest in future research specified on both figurative and verbal measured divergent thinking tasks (Chan et al., 2001; Dudek, Strobel & Runco, 1993). It must be noted, however that a shortened version of the TTCT-test was used for this study.

In conclusion, this study has shown that there is a significant difference between the genders in terms of the development of divergent thinking of four-year-old children. The measured dimensions fluency and originality showed no significant gender differences. Elaboration showed a significant difference, with girls outscoring boys.

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