A gender-comparison between verbal and figural divergent thinking in 4-year-old children, using the Torrance Test of Creative Thinking and the Alternative Uses Task.

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Foreword

First of all I'd like to begin by saying that the past year has been a crazy whirlwind of highs and lows, emotions; both happy and elated, sad and frustrated, a period of triumphs and learning. I've learned a lot about researching, about setting up and conducting an experiment, about writing down the most useful data and creating an article from scratch. I've also learned a lot about myself; I've seen how far I can come and how far I want to come. I've gained a little more insight in the sort of person I am and the sort of person I want to become.

I could not have done this without my amazing, loving and kind parents, however cheesy that might sound. Their support this past year has been phenomenal, their advice priceless and their willingness to help me unparalleled. Thank you for all your help and sympathy and for always pushing me to do new things, even if I don't want to do them! The main reason I'm here, at the possible completion of my master, is because of you.

Another person who deserves my everlasting gratitude is my wonderful, supportive and goofy boyfriend, sometimes punch bag, always quietly there. Thank you for your endless patience whenever I had one of my doubt-moments (and I had a lot of those!), for listening to me raving on about divergent thinking and creativity, for being my number one cheerleader, for providing me with endless supplies of hot tea and biscuits during the writing period of this thesis. Just thank you for being you.

Of course I wouldn't be here without the help of my thesis supervisor HongHong Bai, who dedicated several meetings to explaining the intricacies of data analysing and who has been a great help by providing me with useful feedback and giving me the opportunity to grow. Thank you for letting me participate in your research project.

And last, but certainly not least, a big, big thank you to Lotte, my partner in crime, travel companion, rock, biggest motivator, fellow data analysts and laughing buddy. I couldn't have done it without your support, your wry sense of humour and motivational speeches. Lotte, we did it!

Abstract

Gender differences between verbal and figural divergent thinking in 4-your-old children were examined using the Torrance Test of Creativity, as a figural divergent thinking task, and the Alternative Uses task, as a verbal divergent thinking task. The sample comprised of 100 4-year old children (girls N = 53, boys N = 47). A repeated measures MANOVA, comparing fluency and originality scores from both tests, showed that, overall, girls tend to score higher on fluency. This effect was not found for originality, although girls did score slightly higher on originality than boys. Although the two tests are not comparable, participants did tend to score higher on verbal fluency in comparison to figural fluency. In contrast, with regards to originality, participants tend to score higher on figural originality in comparison to verbal originality. Possible explanations for these results are discussed as well as recommendations for future research. This study suggests that, even at the age of four, there are significant gender differences when testing divergent thinking.

A gender-comparison between verbal and figural divergent thinking in 4-year-old children, using the Torrance Test of Creative Thinking and the Alternative Uses Task.

The concept of creativity and its relationship to young children has increasingly become a source of interest for researchers (Batey & Furnham, 2006; Hoffmann & Russ, 2012; Kim, 2008; Runco & Acar, 2012). However, as research on creativity is usually confined to adolescents and adults, little is actually known of the possible connection between creativity and children, especially preschoolers (Diener, Wright, Brehl, & Black, 2016).

The different components of creativity

Usually research distinguishes two types of operation, which are considered as mental bases for creativity: convergent thinking and divergent thinking (Cho, Te Nijenhuis, Van Vianen, Kim, & Lee, 2010). Convergent thinking involves a single or 'correct' solution or idea for a situation or problem whereas divergent thinking involves the generation of multiple original solutions or ideas for a situation or problem (Cho et al., 2010; Kim, 2008; Runco, & Acar, 2012). The focus of this current research is on divergent thinking, which is a core component of creativity and indicates the creativity potential (Cho et al., 2010; Kim, 2008; Runco, & Acar, 2012).

Verbal and figural divergent thinking

Previous research describes divergent thinking is as multidimensional, with a distinction between verbal and figural factors (Clapham, 2004). Clapham (2004), for example, investigated the possibility of divergent thinking as a multidimensional concept. The study used the verbal and figural Torrance Tests of Creative Thinking (TTCT) and results showed that the two different types of creativity tests did not show convergent validity, which suggests that these two factors are not interchangeable but are in fact different components of divergent thinking.

This concept of multiple dimensionality has also been explored and cautiously confirmed in several neuroimaging studies (Boccia, Piccardi, Palermo, Nori, & Palmiero, 2015; Foster, Williamson, Harrison, 2005). Research suggests that verbal and figural divergent thinking require the activation of different hemispheres. Higher performance on figural tasks is associated with a greater right than left parietal activation, whereas greater left than right parietal activation is associated with higher performance on verbal reasoning (Boccia, et al., 2015; Foster, et al., 2005).

Gender and divergent thinking

It has been widely acknowledged that boys and girls do not follow the same developmental course (Chan et al., 2001). It will be interesting to see whether they also differ from each other on divergent thinking, which is lacking in existing literatures (Lau, & Cheung, 2010). Those studies, which do focus on gender differences and divergent thinking, have varying results and show no consistent pattern. For example, in 2010, Cheung and Lau's study of gender differences in divergent thinking showed that girls tend to score higher on verbal and figural fluency. These results were

also found in Kuhn and Holling's (2009) study of a gender comparison between 12 divergent thinking tests. However Lau and Cheung's study from 2015 showed that males tend to score higher on figural fluency, rather than females. In contrast to the previous studies, the study from Chan et al. (2001) of verbal and figural tests from the Wallach-Kogan Creativity Tests showed that males tended to score higher on verbal tasks but not on figural tasks. And the study from Cheung, Lau, Chan and Wu (2004) showed no gender differences when comparing verbal and figural divergent thinking scores.

All in all, these studies show that research on gender comparison on verbal and figural divergent thinking seems to be inconsistent and lacks an overall conclusion. Moreover, research on gender comparison and its relationship to divergent thinking is mostly confined to adults, adolescents and primary school children above the age of 6. Knowledge on the gender difference on divergent thinking of young children is still under development.

Divergent thinking and its relationship to children

Research has shown that there is a definite correlation between divergent thinking and (early) childhood, with some even suggesting that early childhood is important in the development of divergent thinking (Diener, et al., 2016; Harrington, Block, & Block, 1983; Hoffman & Russ, 2012; Runco, 1992; Runco & Acar, 2012). Harrington, Block and Block (1983) have shown the possible predictive value of divergent thinking in early childhood and subsequent later creative performance. In their study, two divergent thinking tasks (Instances and Unusual Uses) were administered to four and five year olds. Seven years later creative performance was evaluated again. Results showed that early performance on the divergent thinking tests was positively correlated to preadolescent creativity, suggesting that divergent thinking during early childhood might be a predictor of creative performance during adolescence.

Mullinieaux and Dilalla (2009) also investigated the possible predictive role of creative potential, during preschool years, and early adolescent creativity. Pretend play, as a form of creative potential, was measured at the age of five. At the ages of 10 to 15 the participants were asked to complete two divergent thinking tasks (Test for Creative Thinking-Drawing Production and Alternative Uses Measure). Pretend play, observed at the age of five, was found to be a predictor of performance rates on both creative thinking tests. Results showed that more pretend play at the age of five, predicted higher scores on both creative thinking tests, supporting the theory proposed by Harrington and colleagues (1983).

Gaps in existing literature

Although the relation between divergent thinking and children has been widely acknowledged, research on divergent thinking and gender comparison, as mentioned above, is usually confined to adolescents and adults. For example, the studies mentioned above regarding the

difference between verbal and figural divergent thinking have all been conducted with adult participants. Relatively little is known about divergent thinking and the possible gender differences during early childhood. Given that research has shown that early childhood might be an important factor in the development of divergent thinking and later creative performance, it is imperative to try to enhance our understanding of divergent thinking during early childhood, which can then be used, for example, to help design valuable and more effective educational programmes for schools and/or parents. The use of these educational programmes may help to ensure a better development of divergent thinking during early childhood.

Current research

The aim of this research project is to explore the gender difference of divergent thinking in preschoolers, which leads to the following research question: What is the gender difference between the results of the verbal Alternative Uses and the figural Torrance Tests of Creative Thinking, in terms of originality and fluency, when measuring divergent thinking in four-year-olds? Because research on divergent thinking with four-year-olds is slim and research on gender differences offers no conclusive results, it is difficult to form a well-founded hypothesis. However, research shows us that, although language and verbal skills are still developing at the age of four (Jansonius-Schultheiss, Drubble, & Hoogenkamp, 2012), girls tend to have a faster language development than boys (Cheung, & Lau, 2010). One could argue that girls will score higher on verbal tests than boys, due to their slight advantage with regards to language development. According to the Greater Male Variability, males tend to score higher on mathematical and spatial abilities than females (Lau, & Cheung, 2015). One could argue that boys may score higher on figural divergent thinking tasks, which requires spatial abilities, than girls. The current research tries to explore these possible gender differences on verbal and figural divergent thinking.

Method

Participants

Four primary schools in the Netherlands have agreed to participate in this project. Participants were four-year-olds (N=100, girls N=53, boys N=47), with a mean age of 4.43 years and a standard deviation of .28. Several schools in the Netherlands were approached to participate in this project. Schools, who were interested in participating, received an email containing the details of this project. When they agreed to participate, permission forms were send out to the parents. Only the children, whose parents signed a permission form, were included in this sample.

Materials

To test divergent thinking, two tests were selected: Alternative Uses (AU) as a verbal divergent thinking test and the Torrance Tests of Creative Thinking (TTCT) as a figural divergent thinking test. Both tests are seen as valid measures of divergent thinking (Batey & Furnham, 2006;

Cho et al, 2010; Clapham, 2004; Gilhooly, Fioratou, Anthony, & Wynn, 2007; Kim, 2006; Runco, 1992; Runco & Acar, 2012).

The AU test we used in this study was adjusted from what Gilhooly and colleagues (2007) used in their study. It consists of six pictures, each depicting a different object: a washcloth, a brick, a broom, a basket, a fishing net, and a spoon. For each item, the participant is asked to name what they see and is then asked to describe or come up with as many different uses for said object as possible. Two scores are calculated from the child's responses to six objects: (1) fluency, the number of acceptable uses generated by the child and (2) originality, the number of acceptable uses given by a child (Hoffmann & Russ, 2012; Runco, 1992).

The TTCT consists of three activities: picture construction, picture completion and repeated figures of lines. Each activity requires about ten minutes to complete. Just like the AU, we adjusted the TTCT to better suit our participants' age category; we translated the activities in Dutch and simplified the instructions. Activity 1 consists of a stimulus in the shape of an egg. Participants are required to incorporate the stimulus in their picture construction. Activity 2 consists of 10 incomplete figures. The participant is asked to use the incomplete figure and, by adding lines, colour and details, to try and create as many pictures or objects as possible. Activity 3 consists of three pages of sets of parallel lines. The participant is asked to use the pairs of lines and incorporate them in their picture, to try and create as many pictures or objects as possible (Clapham, 2004; Cho, et al., 2010; Kim, 2006). Both the AU and the TTCT were scored for fluency and originality.

Procedure

The participants were asked to accompany the researcher to a slightly secluded room, where they were invited to sit by a table. All participants were tested using both the AU and the TTCT, however it was ensured that none of the participants was tested twice on the same day, to prevent wearing out the participants, which can possibly compromise the results. Both tests were recorded, using a video camera on a tripod, with the camera facing the participant and a part of the table (to capture the drawing process during the TTCT). Each test started with a small conversation between researcher and participant to help the participant feel more at ease and become familiar with the researcher. Topics ranged from family and friends, favourite past-times or hobbies and school experiences.

The Alternative Uses test

Each AU test was preceded with an example to introduce the participant to the test and to ensure that the participant understood what was asked of him or her. The six pictures were lying face down, so the participant couldn't see their contents. Using a newspaper, the researcher demonstrated the main use (reading) and several different uses of a newspaper, using thinking out loud tactics ("Maybe I can think of something else to use a newspaper for"), providing examples

(Folding a hat or an aeroplane from the newspaper and showing it to the participant) and inviting the participant to think along with the researcher for possible uses ("Can you think of anything else that we can use a newspaper for?"). After the example with the newspaper, the participant was asked if he/she understood what the task comprised of and, on receiving an affirmative, was presented with each of the pictures of the AU. All pictures were shown in a random sequence among the participants. The participant was asked to name the object on the picture and try to come up with as many different uses as possible. During the test the researcher provided the participant with many compliments to keep the participant inspired and motivated. If the participant paused, several prompts were provided ("Can you think of more uses for * "; Do you want to think about it some more?"). When the participant indicated that he/she was unable to think of any more uses, the researcher presented the next picture. The test took about 12 to 24 minutes to complete. When the test was completed, the participant was thanked for their time and complimented for their effort and escorted back to the class.

The Torrance Tests of Creative Thinking

With each TTCT test the participant was presented with a number of colourful pens. Each test comprised of three items and each item took about 10 minutes to complete. All three items were printed on different sheets of paper and were turned face down at the beginning of the test. When the participant indicated that he/she was finished, the researcher asked what the participant had drawn and the participant was asked to name each picture. When the test was completed, the participant was thanked for their time and complimented for their effort and escorted back to the class.

Scoring AU and TTCT

The responses of 100 children to the items of the AU and the TTCT were scored for fluency (number of acceptable ideas) and originality (number of original ideas). Fluency for both TTCT and AU was scored based on the number of responses. Each response was given 1 point. The fluency scores for each response were then added to form a total fluency score per participant per different test. For both tests originality was scored based on the frequency of the response. The more frequent a response was mentioned by children for the same item, the less original the response was, which meant a lower originality score. To determine the originality scores, a response, that was mentioned by less than 5% of the participants, was given 2 points; a response, that was mentioned by 5 till 10% of the participants, was given 1 point and a response, that was mentioned by more than 10%, was given 0 points. The originality scores for each response were then added to form a total originality score per participant per different test.

Results

This study aims to explore the possible gender differences between children's performance on verbal divergent thinking task (i.e. AU task) and on figural divergent thinking task (i.e. TTCT test). As explained in the Method, divergent thinking in both tasks is evaluated on fluency and originality. To examine the differences between two tasks and taking gender into consideration, a repeated measures MANOVA is conducted, in which the type of tasks is the within subject factor and the gender is the between subject factor. Boxplots and Shapiro-Wilk statistics indicate that the assumption of normality s supported; F_{max} is 1.399, demonstrating homogeneity of variances; and Mauchly's test indicates that the assumption of sphericity is not violated. Table 1 presents the number of participants, means and standard deviations of the AU and the TTCT for both genders and the total scores.

Table 1

Number of participants, Means, and Standard Deviations for AU and TTCT

		Girls (N = 53)		Boys (N = 47)		Total (N = 100)	
		M	SD	M	SD	M	SD
TTCT	Fluency	12.26	6.58	9.17	6.84	10.81	6.85
	Originality	9.09	5.38	8.32	5.79	8.73	5.56
AU	Fluency	16.19	7.42	15.45	6.59	15.84	7.01
	Originality	6,81	6,60	7,28	5,30	7,03	5,99

Note. N = number of participants; M = means; SD = standard deviations

The results of the repeated measures MANOVA show that the main effect of the type of test, F (1,98) = 54.716, $p < .001$, partial $\eta^2 = .530$, is significant, with an observed power of 1.000. The main effect of gender is also significant, F (1,98) = 4.380, $p = .010$, $\eta^2 = .091$, with an observed power of .788. The interaction between the type of test and gender is not significant, F (1,98) = .695, $p = .502$, partial $\eta^2 = .014$, with an observed power of .164.

An ANOVA is used to analyse the gender and test differences on fluency and originality. For fluency, the effect of test type is significant, F (1,98) = 25.590, $p < .001$, partial $\eta^2 = .207$, with an observed power of .999 and the effect of gender is significant, F (1,98) = 4.183, $p = .044$, partial $\eta^2 = .041$, with an observed power of .526. Girls score significantly higher on fluency (M = 14.226, SD = .643) than boys (M = 12.309, SD = .683). The interaction between the test type and gender is not significant, F (1,98) = 1.360, $p = .246$, $\eta^2 = .014$, with an observed power of .211.

For originality, a slight significant effect for the type of test is found, F (1,98) = 4.158, $p = .044$, partial $\eta^2 = .041$, with an observed power of .524. No gender effect is found for originality,

F (1, 98) = .035, p = .852, partial η^2 = .000, with an observed power of .054. However, although no significant gender effect was found, overall girls (M = 7.953, SD = .569) did tend to score slightly higher than boys (M = 7.798, SD = .604) on originality. The interaction between the test type and gender is not significant, F (1,98) = .579, p = .449, η^2 = .006, with an observed power of .117. Figure 1 shows the means for fluency and originality for girls and boys.

Figure 1. Gender means for Fluency and Originality

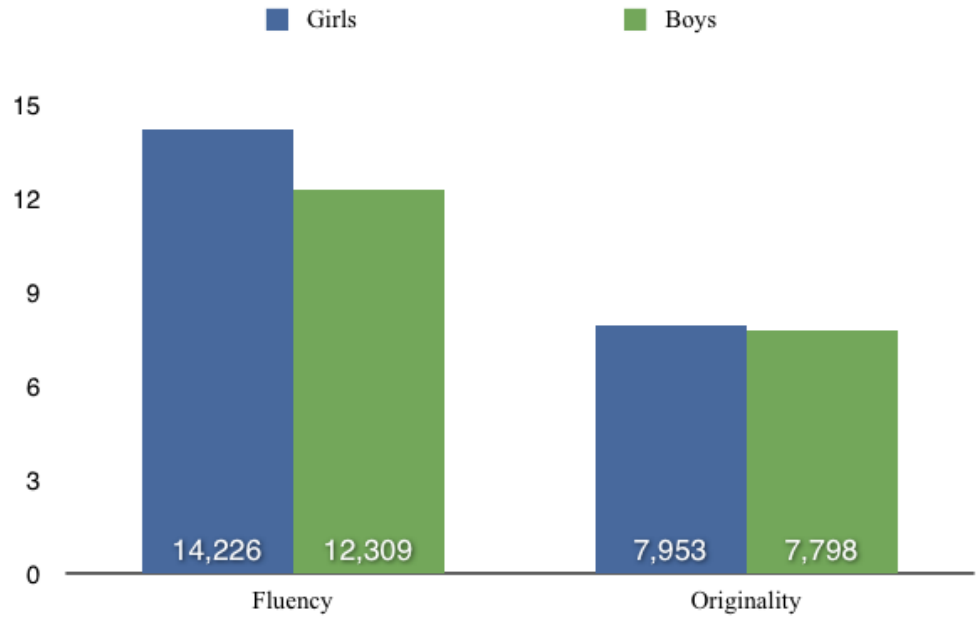

Figure 1. Means for Fluency and Originality. Blue indicates girls' mean, green indicates boys' mean.

Although the results of the AU and the TTCT cannot be compared directly, results show that participants tend to score higher on verbal fluency (M = 15.818, SD = .705) in comparison to figural fluency (M = 10.717, SD = .671). The opposite was found when looking at verbal and figural originality; results here show that the participants tend to score higher on figural originality (M = 8.707, SD = .559), in comparison to verbal originality (M = 7.044, SD = .604). Figure 2 shows the means for fluency and originality for the figural TTCT and the verbal AU.

Figure 2. Figural and verbal means for Fluency and Originality

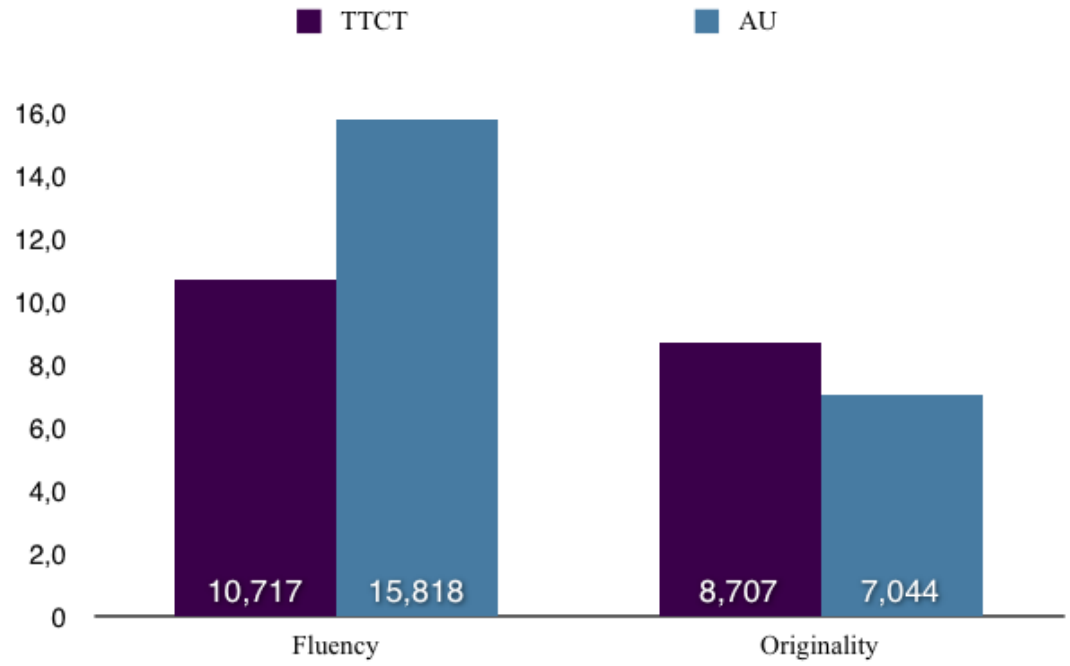

Figure 2. Means for fluency and originality. Purple indicates the mean on the TTCT; blue indicates the mean on the AU. The TTCT is a figural divergent thinking test and the AU a verbal divergent thinking test.

Discussion

Current research

Past research has shown that early childhood might be an important period in the development of divergent thinking and for later creative performance (Diener, et al., 2016; Harrington, Block, & Block, 1983; Hoffman & Russ, 2012; Runco, 1992; Runco & Acar, 2012). However little research has been conducted on divergent thinking during the early childhood. When examining divergent thinking, research often makes a distinction between verbal and figural divergent thinking, with both components possibly activating different brain regions (Boccia, et al., 2015; Clapham, 2004; Foster, et al., 2005). Another important aspect of studying divergent thinking is gender differences. Previous studies have shown that research about gender difference and divergent thinking yields different results (Lau, & Cheung, 2010). There is also a distinct lack of research on gender differences with regards to divergent thinking during the early childhood. This study tries to fill this void and explore the gender difference between verbal and figural divergent thinking in 4-year-olds. A more thorough understanding of divergent thinking in early childhood and possible gender differences could help for example to design more effective educational

programmes for schools or parents to enhance the development of divergent thinking during early childhood.

Gender differences

With regards to gender differences: figure 1 in the Results section shows that girls tend to score higher on both verbal and figural fluency. However, no significant gender effect was found for originality, although girls did tend to score slightly higher on originality in comparison to their male counterparts. These findings corroborate in parts the results of Kuhn and Hollings (2009), who also found that girls tend to score significantly higher than boys on both fluency and originality. These findings are also congruent with the results that Kousoulas and Mega (2009) found in their study, carried out in Greece. In their study, girls outperformed boys on fluency, but not on originality. Kousoulas and Mega also reported that originality was not influenced by gender and they proposed that the gender differences found for fluency, especially for verbal fluency, can be explained due to girls' slightly more advanced language development, which means girls tend to be more fluent and are able to express themselves better, which could lead to higher divergent thinking scores on fluency. Baer and Kaufman (2008) also argued that preschool girls are linguistically more competent than preschool boys, which might explain higher scores on divergent thinking tests. Moreover, Baer and Kaufman argued that the lack of gender influence on originality might be explained by the idea that children, at such an early age, may not yet exhibit the kind of creative achievement on originality in which gender differences are apparent.

Figural and verbal divergent thinking

The findings about the difference between figural and verbal divergent thinking cannot lead to any conclusion due to the different testing stimuli. However, they used the same scoring method: fluency scores are determined by the number of reasonable ideas, and originality scores are determined by the infrequency of generated ideas. It might therefore be valuable to note that opposite trends of fluency and originality between genders were found when comparing the figural TTCT and the verbal AU; participants tend to score higher on figural originality in comparison to verbal originality. The opposite was found for fluency; here, participants tend to score higher on verbal fluency rather than figural fluency.

The overall higher verbal fluency scores in comparison to figural fluency scores were also found in Lau and Cheung's study (2010). One could argue that the higher verbal fluency scores could be attributed to the type of tests that were used in this particular research project. Fluency, in this study, is described as the number of acceptable ideas. The TTCT has a limited number of drawings (a total of 26 drawings), which means that a participant can generate up to 26 acceptable ideas (one for each drawing). The AU, on the contrary, has no limit on the number of acceptable ideas a participant can produce per object. In theory this could mean that a participant could get a

higher verbal fluency score (on the AU), simply due to the lack of a set number of ideas, as is the case with the TTCT fluency scores.

One possible explanation for the lower verbal originality scores compared to the figural originality scores, and one certainly worth investigating, could be the cultural influence on the ability to produce original ideas. According to Chan et al. (2001) originality scores could be culturally specific, more so than fluency scores. At the age of four, children in the Netherlands are taught that certain objects are used for only one or two purposes (a toothbrush for example is only used for brushing your teeth, not for cleaning the toilet or for crafting). This idea of only using an object for one single purpose is instilled during early childhood and this type of conditioning discourages young children to think of multiple purposes for certain objects, which may in turn influence their ability to think of original ideas. Drawing on the contrary is stimulated and praised during early childhood, especially at school, and children are encouraged to develop and hone their drawing skills. Since the originality scores from the AU are based on the ability to produce multiple, original uses for an object, it could explain the lower scores in comparison to the TTCT scores, which relies on drawing multiple original ideas.

Strengths and weaknesses

This study has several aspects that could use some improvement. The four primary schools used in this study were from roughly the same area in the Netherlands and the same setting (a suburban setting), which makes it difficult to generalise these findings to the whole country. With regards to the testing procedure, testing of both the AU and the TTCT were done in relatively open spaces or large rooms, which meant little privacy and could provide several distractions during the testing (such as people walking in and out of the room). This may have impacted the results.

However, this study also has several strong points that work in its favour. The boy-girl ratio was almost evenly distributed, with 53 girls and 47 boys, which meant that comparison between these two groups was possible. The two divergent thinking tests that were used, are both seen as valid measures of divergent thinking (Batey & Furnham, 2006; Cho et al, 2010; Clapham, 2004; Gilhooly, Fioratou, Anthony, & Wynn, 2007; Kim, 2006; Runco, 1992; Runco & Acar, 2012). Especially the TTCT is one of the most used tests when measuring divergent thinking (Runco, & Acar, 2012). The results showed that the assumptions of normality, homogeneity of variance and sphericity were all met, which lends more credit to the results.

Recommendations for further research

Although the sample size was adequate for this particular study, further research could include a larger sample, to further investigate divergent thinking in early childhood. The use of other divergent thinking tests in addition to the two used in this study, may also offer more insight. Because this study was conducted in four schools that were largely comparable in terms of type of

education and setting (all four schools were situated in suburban areas for example), additional studies could include different settings, such as big city schools, rural schools etc.. There is also a definite lack of longitudinal research on divergent thinking, its development and possible gender differences at different ages. Further research could include continuation of this study through different stages of childhood.

Conclusion

This study suggests that, even at the age of four, there are significant gender differences when testing divergent thinking. It is important to continue investigating the relationship between divergent thinking, early childhood and gender differences, to gain better understanding of the development of divergent thinking, which, in turn, can help us to create environments and educational programmes that help children develop divergent thinking to its utmost potential.

References

Baer, J., & Kaugman, J. C. (2008). Gender differences in creativity. *Journal of Creative Behavior, 42,* 75-105.

Batey, M., & Furnham, A. (2006). Creativity, intelligence and personality: A critical review of scattered literature. *Genetic, Social, and General Psychology Monographs, 132*, 355-429.

Boccia, M., Piccardi, L., Palermo, L., Nori, R., & Palmiero, M. (2015). Where do bright ideas occur in our brain? Meta-analytic evidence from neuroimaging studies of domain-specific creativity. *Frontiers in Psychology, 6,* 1-12. doi:10.3389/fpsyg.2015.01195

Chan, D. W., Cheung, P.C., Lau, S., Wu, W. Y. H., Kwong, J. M. L., & Li, W. (2001). Assessing ideational fluency in primary students in Hong Kong. *Creativity Research Journal, 13,* 359365. doi:10.1207/S15326934CRJ1334_13

Cheung, P. C., Lau, S., Chan, D. W., & Wu, W. Y. H. (2004). Creative potential of schoolchildren in Hong Kong: Norms of the Wallach-Kogan Creativity Tests and their implications. *Creative Research Journal, 16,* 69-78.

Cheung, P. C., & Lau. S. (2010). Gender differences in the creativity of Hong Kong school children: Comparison by using the new electronic Wallach-Kogan Creativity Tests. *Creativity Research Journal, 22*, 194-199. doi:101080/10400419.2010.481522

Cho, S. H., Te Nijenhuis, J., Van Vianen, A. E. M., Kim, H., & Lee, K. H. (2010). The relationship between diverse components of intelligence and creativity. *Journal of Creative Behavior, 44,* 125-137.

Clapham, M. M., 2004. The convergent validity of the Torrance Tests of Creative Thinking and creativity interest inventories. *Educational and Psychological Measurement, 64,* 828-841. doi:10.1177/0013164404263883

Diener, M. L., Wright, C., Brehl, B., & Black, T. (2016). Socioemotional correlates of creative potential in preschool age children: Thinking beyond students academic assessments. *Creativity Research Journal, 28,* 450-457. doi:10.1080/10400419.2016.1229975

Foster, P. S., Williamson, J. B., & Harrison, D. W. (2005). The Ruff Figural Fluency Test: Heightened right frontal lobe delta activity as a function of performance. *Archives of Clinical Neuropsychology, 20,* 427-434. doi:10.1016/j.acn.2004.09.010

Gilhooly, K. J., Fioratou, E., Anthony, S. H., & Wynn, V. (2007). Divergent thinking: Strategies and executive involvement in generating novel uses for familiar object. *British Journal of Psychology, 98,* 611-625. doi:10.1348/096317907X173421

Harrington, D. M., Block, J., Blok, J. H. (1983) Predicting creativity in preadolescence from divergent thinking in early childhood. *Journal of Personality and Social Psychology, 45,* 609-623.

Hoffmann, J., & Russ, S. (2012). Pretend play, creativity and emotion regulation in children. *Psychology of Aesthetics, Creativity and the Arts, 6,* 175-184. doi:10.1037/a0026299

Jansonius-Schultheiss, K., Drubbel, A. M. A., & Hoogenkamp, G. M. (2012). Taaldiagnostiek. In Kievit, T., Tak, J. A., & Bosch, J. D. (Eds.) *Handboek Psychodiagnostiek voor de Hulpverlening aan Kinderen* (pp 497-535). Utrecht: De Tijdstroom.

Kousoulas, F. , & Mega, G. (2009). Students' divergent thinking and teachers' ratings of creativity: gender play a role? *Journal of Creative Behavior, 3,* 209-222.

Kim., K. H. (2006). Can we trust creativity tests? A review of the Torrance Tests of Creative Thinking (TTCT). *Creativity Research Journal, 18,* 3-14.

Kim, K. H. (2008). Meta-analyses of the relationship of creative achievement to both IQ and divergent thinking test scores. *Journal of Creative Behavior, 42,* 106-130.

Lau, S., & Cheung, P. C. (2010). Developmental trends of creativity: What twists of turn do boys and girls take at different grades? *Creativity Research Journal, 22,* 329-336. doi:10.1080/10400419.2010.503543

Lau, S., & Cheung, P. C. (2015). A gender-fair look at variability in creativity: Growth in variability over a period versus gender comparison at a time point. *Creativity Research Journal, 27,* 87-95. doi:10.1080/10400419.2015.992685

Mullineaux, P. Y., & Dilalla, L. F. (2009). Preschool pretend play behaviors and early adolescent creativity. *The Journal of Creative Behavior, 43,* 41–57. doi:10.1002/(ISSN)2162-6057

Runco, M. A. (1992). Children's divergent thinking and creative ideation. *Developmental Review, 12,* 233-264.

Runco, M. A., & Acar, S. (2012). Divergent thinking as an indicator of creative potential. *Creativity Research Journal, 24,* 66-77. doi:10.1080/10400419.2012.652929