Identifying Highly Gifted Children by Analyzing Human Figure Drawings: An Explorative Study

A. C. Sven Mathijssen[1,*], Max J. A. Feltzer[2], and Lianne Hoogeveen[1]

Abstract: In the present study, human figure drawings (HFDs) of 47 highly gifted children and 73 non-gifted children aged 7 to 9 years were examined. The Goodenough-Harris Drawing Test (GHDT) and Naglieri's Draw a Person: A Quantitative Scoring System (DAP:QSS) were used. None of the instruments showed significant differences in drawing-IQ between the two groups of children. However, closer examination showed that different items were present in the HFDs of highly gifted and non-gifted children. Out of 135 found items, 30 items were considered to be 'exceptional' and a possible indicator for giftedness. These findings suggest that analyzing HFDs on item level may be more helpful in identifying highly gifted children than computing drawing-IQs.

Keywords:
highly gifted children, human figure drawings

The concept of giftedness has been a topic of interest for scientific investigation, ever since the 'Intelligence Quotient' (IQ) was introduced to quantify the mental abilities of people in the early twentieth century (Carson, 2001). Someone with a high IQ score was and still is considered to be 'gifted' (Terman, 1926; Calero, Belen, & Robles, 2011). Measurement of IQ is most commonly completed with the Wechsler tests (Camara, Nathan, & Puente, 2000).

However, what is considered to be gifted in recent scientific literature goes beyond a high IQ. For example, the role of creativity—in the form of generating novel ideas, thinking flexibly and out-of-the-box (Sternberg, 2004)—is considered as a part of some models concerning giftedness (e.g. Mönks & Mason, 2000; Renzulli, 2003; Ziegler, Vialle, & Wimmer, 2013). Matthews and Folsom (2009) concluded that it would make better sense to identify the particular cognitive domains in which a child is talented, rather than saying a child is 'gifted'. In short, giftedness has become a vague concept (Borland, 2005), which is understandable considering the many different views on the subject.

Given the notions mentioned above, detecting highly gifted children is not an easy task, especially if a child is a so-called 'underachiever' (Dowdall & Colangelo, 1982; Karwowski, 2008; Majid & Alias, 2010; Mooij, 2013; Preckel, Holling, & Vock, 2006; Reis & McCoach, 2000). After studying many views on underachievement, Dowdall and Colangelo (1982) define underachievement as "a discrepancy between potential (what a student ought to be able to do) and actual performance (what a student is actually demonstrating)" (p. 179). The classic example would be the underachieving child who achieves highly on an intelligence test, but performs at a relatively low level in school (Preckel et al., 2006). It is also possible that a child may score at a relatively low level on

[1] *Center for the Study of Giftedness, Radboud University, the Netherlands*
** Corresponding author. Center for the Study of Giftedness, Radboud University, Mercator 2, Toernooiveld 300, 6525 EC Nijmegen, the Netherlands. Tel.: +31 243616146. Email: s.mathijssen@its.ru.nl*
[2] *Department of Developmental Psychology, Tilburg University, the Netherlands*

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an intelligence test despite high potential, which can be identified through unusual scoring patterns on intelligence tests (Gallagher, 1991; Silverman, 1990). At the consulting practice of the Center for the Study of Giftednes (CBO)[1] many children, most of whom are thought to be gifted, give unusual answers to questions. Those answers are not necessarily wrong, but cannot be considered correct, because they are not mentioned in the scoring manuals of the used tests. This may explain why many professionals in the fields of psychology and education still fail to recognize and serve highly gifted children, despite broadened definitions of giftedness, intelligence and creativity (Reis, 2009).

Looking beyond regular testing seems advisable; according to Pfeiffer and Blei (2008) "there exists no precise cut score or set of characteristics that differentiate gifted from not-gifted" (p. 178), but most gifted programs still rely on standardized measures, such as intelligence tests or measures of achievement (McBee, 2010). This suggests that a lot of gifted children will remain unrecognized and consequently underserved in schools. Therefore, professionals are in need of improved identification procedures. The present study aimed to investigate whether the identification of highly gifted children might be improved by analyzing human figure drawings (HFDs). In the past, analyzing HFDs was accepted by both clinicians and educators as a method for measuring the cognitive capacities of children (Reisman & Yamokoski, 1973). This method is still used in diagnostic assessment (Camara et al., 2000; Imuta, Scarf, Pharo, & Hayne, 2013; Lange-Küttner, 2011), but nowadays experts take different, rather polarized positions concerning the use of HFDs.

On the one hand there are experts with positive views on the use of HFDs, who state that scoring instruments show significant correlations with intelligence tests (see Abell, Von Briesen, & Watz, 1996; Abell, Wood, & Liebman, 2001). The Goodenough-Harris Drawing Test (GHDT) (Harris, 1963), an instrument for analyzing HFDs that is widely used, has been investigated in many studies. Reliability coefficients, including inter-rater reliability, were commonly above .90 (Abell et al., 2001). Validity coefficients ranged from .26 to .92, depending on which intelligence test the GHDT was correlated with (Abell et al., 1996; Harris, 1963). The reliability of the Draw a Person: A Quantitative Scoring System (DAP:QSS) (Naglieri, 1988) has also been investigated in many studies and can also be judged as good to excellent, with coefficients for inter-rater reliability ranging from .86 to .99 (Abell et al., 2001; Willcock, Imuta, & Hayne, 2011). Coefficients of internal consistency of the DAP:QSS Total Score range from .83 to .89, which denotes acceptable to good internal consistency over 14 scoring criteria. With regard to the concurrent validity, significant correlations (ranging from .36 to .53) between DAP Total Score and WISC-IQ were revealed (Abell et al., 2001).

Schepers, Dekovič, Feltzer, De Kleine, and Van Baar (2012) found the DAP:QSS to be a useful parameter for evaluating cognitive functioning. HFDs seem to be helpful when using them within a larger test battery (Dykens, 1996); they can complement data from other tools that measure cognitive abilities. A recent study by Arden, Trzaskowski, Garfield and Plomin (2014), in which the HFDs of 7,752 pairs of twins at the ages of 4 and 14 were analyzed, shows that greater accuracy in children's drawings is significantly associated with higher intelligence, although the correlation is not strong. HFDs may also prove to be useful in the case of test anxiety, which is a possible cause for academic underachievement (Harris & Coy, 2003). According to Flanagan and Motta (2007), "When a child is asked to 'draw a person,' that child is likely engaging in an activity that he or she has done many times and is therefore often not threatened by this task" (p. 267). This consequently may prevent test anxiety.

[1] The Center for the Study of Giftedness is an academic center of expertise in the field of giftedness. See http://www.ru.nl/its/cbo/.

On the other hand, there are reasons for not using HFDs. Lilienfeld, Wood, and Garb (2000) stated that "the scientific status of scores derived from HFDs can best be described as weak" (p. 51). Correlations with intelligence tests are often actually quite modest (Abell et al., 1996; Abell et al., 2001). Scoring systems for HFDs may be more strongly related to visual-motor development than to intelligence (Dykens, 1996) and HFDs may yield a high number of false positives and false negatives for low intellectual functioning, rendering them not useful as a tool to measure intellectual ability (Willcock et al., 2011). Most studies have used the GHDT or the DAP:QSS. These instruments are relatively old, but according to Imuta, Scarf, Pharo, and Hayne (2013), the more recent Draw a Person Intellectual Ability Test for Children, Adolescents, and Adults (DAP:IQ) (Reynolds & Hickman, 2004) also yields high numbers of false positives and false negatives for borderline and superior intellectual functioning. They had to conclude that this more recent scoring system, too, should not be used to measure intelligence. They ended their argumentation with the advice to "draw an end to [practitioners'] use of children's HFD tests as a surrogate measure of children's intelligence" (p. 7). Despite the downsides on the use of HFDs as mentioned above, Lilienfeld et al. (2000) encourage further research on global scoring approaches. If further research were completed, the issues causing the high numbers of false positives and false negatives—such as high artistic skills or high creative talent expressed in drawings (Lubart, Georgsdottir, & Besançon, 2009)—may be resolved.

To summarize, there are some strong arguments not to use HFDs as a tool to measure intelligence; although the reliability can be judged as good or excellent, they appear to be less valid than desired with regard to measuring intelligence. However, the present study does not aim at measuring intelligence, because *identifying* giftedness goes beyond *measuring* intelligence (Pfeiffer & Blei, 2008). Analyzing HFDs for the purpose of identifying gifted children is a different approach that has not yet been studied.

The goal of a pilot study by Mathijssen (2011) was to determine whether differences in drawing-IQs between highly gifted and non-gifted children could be found. In this study, children who exceeded the standard school curriculum, visible in cognitive and/or creative performance, were referred to as (highly) gifted. The results showed that, for children in the age range of 7 to 9, highly gifted children scored significantly higher on the GHDT than non-gifted children. The results also showed that it was not possible to detect giftedness in HFDs of older children, although a non-significant trend was found in the group of older children (aged 10 to 12). Overall, the results of this pilot study were not convincing, given the small effect size.

The present study further explored if and how highly gifted children in the age range of 7 to 9 differ from same-aged non-gifted children in their HFDs. The first research question was: "Can highly gifted children be identified by their drawing-IQs?" Given the modest validity of drawing-IQs found in many studies, no large differences between highly gifted and non-gifted children were expected. The second research question was: "Can highly gifted children be identified by particular items found in their HFDs?" It was expected that highly gifted children would draw unusual details in the human figure and would draw additional details apart from the human figure, because they were expected to think divergently (Batey, Chamorro-Premuzic, & Furnham, 2009), be more creative (i.e. Piirto, 2005), and therefore produce more novel drawings when compared to non-gifted children.

Method

Participants

Participants were 120 children (69 boys, 51 girls) from six different schools across the Netherlands. The sample size warrants sufficient statistical power (.80) to detect medium effects, using Cohen's (1988) criteria. The age span was 7 to 9 years (M = 7.87, SD = 0.83). The children were divided into two giftedness groups: highly gifted and non-gifted. The highly gifted group comprised 47 children (29 boys, 18 girls) from Leonardo-education, a gifted education provision in Holland. A total IQ of 130 or higher was assumed because this is the minimum limit for entry into Leonardo-education. Four children from Leonardo-education were diagnosed with autism spectrum disorder (ASD). The drawings of these children were excluded from statistical analysis. The non-gifted group comprised 73 children (40 boys, 33 girls) from regular education services. In classrooms in regular education, there may also be highly gifted children or children with ASD. If this was the case (determined by psychological evaluation) or there were children thought to be gifted or have an ASD, the drawings of these children were also excluded from statistical analysis (see Procedure). Two children were excluded from analysis due to teachers' suspicions of giftedness and two children were excluded due to teachers' suspicions of ASD. There were no checks to confirm if the suspicions were warranted.

Materials

Goodenough-Harris Drawing Test (GHDT). As one of two scoring systems for analyzing HFDs, the GHDT (Harris, 1963) was used. Depending on the gender of the drawn person, the GHDT uses different lists for the drawn items that should be scored. The GHDT uses 73 items for scoring a drawn man and 71 items for scoring a drawn woman. The sum of items can be compared to norms of age and gender and can be converted to a drawing-IQ. However, the absolute IQ-score was not the main target of the present study. The difference in scores between highly gifted and non-gifted children was considered to be most important. The non-gifted group also served as a control for a possible Flynn effect (Flynn, 1984) on this older drawing test. The GHDT has been developed for children in the age range of 3 to 15. The reliability, including the inter-rater reliability, can be judged as good or excellent, as mentioned in the Introduction.

Naglieri's Draw a Person: A Quantitative Scoring System (DAP:QSS). The second scoring system was the DAP:QSS (Naglieri, 1988). The DAP:QSS uses 64 items, spread out over 14 criteria on which the drawing should be scored. The DAP:QSS has been developed for children in the age range of 5 to 17. The reliability, including the inter-rater reliability, can also be judged as good or excellent (Abell et al., 2001; Willcock, Imuta, & Hayne, 2011), as mentioned in the Introduction.

Procedure

The schools of the children participating in the present study were informed by telephone and/or by letter about the purpose of this study. The management of the schools sent a letter to the parents of the children, stating that an investigation would take place and their children would participate, if they would grant their permission. They were asked to inform their schools when granting permission or objecting. Almost all parents (99%) granted permission for their child to participate in the present study.

The schools received the instructions for the drawing task by mail, because the investigators would not be present at the time of the drawing session. The teachers were asked to instruct the children exactly according to the instructions sent by the investigators and were informed about the importance of strictly doing so.

The teacher gave the children verbal instructions for the HFD, which were based on the DAP:QSS's (Naglieri, 1988) instructions and were aimed at preventing test anxiety as far as possible. The instructions were: "In a little while you will receive an empty sheet of paper. On this sheet, you will draw a human figure with a pencil. You will have about ten minutes to do this. You can use the entire sheet. There are no right or wrong drawings. Wait until you get a sign before you start drawing. When you are ready, put down your pencil. On the back of the sheet, you can write down your birthday, if you are a boy or a girl and the name of your school."

After the instruction, the teacher handed out empty sheets of paper of A4 size. When a sign was given, the children were allowed to start drawing. After ten minutes, they were asked to finish their drawings and, if necessary, they were given a couple of minutes more. When the children finished drawing, the drawings were handed in. After this, the teacher explained the purpose of the study as: "finding similarities and differences in the drawings of children from different elementary schools". There were no manipulation checks to ensure that the teachers abided by the instructions. Responses provided by the teachers when children asked questions were not recorded.

The schools were provided with stamped envelopes for the drawings to be posted to the investigators. In Leonardo-education, the drawings of children who were diagnosed with (or suspected to have) ASD were marked by the teacher at the top right corner of the sheets. In regular education, this concerned the drawings of children who were diagnosed (or suspected to be) gifted or autistic.

The drawings were scored according to the guidelines set out in the manuals of the GHDT and the DAP:QSS. Formally, three drawings (man, woman and self) per child are required to compute total drawing-IQs. Because the children were asked to only draw one human, the gender of the drawn person was taken into account when scoring the drawing. Based on the gender, the appropriate norms for scoring the drawings were used. Nine drawings (six by highly gifted children) only contained a facial close-up of a human figure; these drawings were excluded from statistical analysis.

After scoring the drawings in accordance with the manuals, the drawings were analyzed blindly and independently on item level by two investigators who were trained to do so. Items which were only present in drawings of highly gifted children and for which an inter-rater agreement of 100% was found, were considered 'exceptional' and a possible indication of giftedness.

Results

Drawing-IQ

For highly gifted children, the GHDT drawing-IQs ranged from 77 to 151 and the DAP:QSS drawing-IQs ranged from 58 to 135. For non-gifted children, the GHDT drawing-IQs ranged from 77 to 139 and the DAP:QSS drawing-IQs ranged from 69 to 127. In the non-gifted sample, no boy drew a woman and one girl drew a man. In the highly gifted sample, two boys drew a woman and no girl drew a man. All other children drew a human figure of their own gender.

To determine whether or not the mean drawing-IQs of highly gifted and non-gifted children differed significantly from each other, two-way ANOVAs were completed, intelligence group and gender being the independent variables (see Table 1 and Table 2 for mean scores and standard deviations).

Table 1
GHDT Mean Scores and Standard Deviations for Highly Gifted and Non-gifted Boys and Girls

	Highly gifted		Non-gifted	
	Boy	Girl	Boy	Girl
n	29	18	40	33
Mean score	101.03	111.39	104.78	109.30
Standard deviation	14.64	18.82	13.90	9.89

Table 2
DAP:QSS Mean Scores and Standard Deviations for Highly Gifted and Non-gifted Boys and Girls

	Highly gifted		Non-gifted	
	Boy	Girl	Boy	Girl
n	29	18	40	33
Mean score	92.10	103.67	95.73	106.27
Standard deviation	14.96	17.04	13.37	10.66

The results show no significant interaction effects for the GHDT, $F(1, 119) = 1.20$, $p = .277$, $\eta_p^2 = .01$, nor for the DAP:QSS, $F(1, 119) = 0.04$, $p = .846$, $\eta_p^2 = .00$, and also no significant main effects for intelligence group (GHDT: $F(1, 119) = 0.10$, $p = .757$, $\eta_p^2 = .00$; DAP:QSS: $F(1, 119) = 1.42$, $p = .236$, $\eta_p^2 = .01$). The results show a main effect for gender, with girls scoring higher than boys in both giftedness groups on both scoring systems (GHDT: $F(1, 119) = 7.79$, $p = .006$, $\eta_p^2 = .06$; DAP:QSS: $F(1, 119) = 17.89$, $p < .001$, $\eta_p^2 = .13$).

Furthermore, on the GHDT, 5 highly gifted (10.6%) and 2 non-gifted (2.7%) children scored 130 or more; only 1 highly gifted child (2.1%) got a score higher than the highest score (= 139) in the group of non-gifted children. On the DAP:QSS, 3 highly gifted children (6.4%) and none of the non-gifted children scored 130 or higher; 3 highly gifted children (6.4%) got a score higher than the highest score (= 127) in the group of non-gifted children.

Item level

To determine whether or not highly gifted children draw items that are not drawn by non-gifted children (or vice versa), every perceivable item within a drawing was noted. A total of 135 items were noted, on which a mean inter-rater agreement of 97.6% was found. For 30 of 31 items (22.2% of all noted items) that were only found in the drawings of highly gifted children, an inter-rater agreement of 100% was found. These involved: a head from the side, eye make-up, mucus, freckles, a goatee, braces, a bow tie, a tie, a badge, a waist, nipples, hair on the arms, hands put in the pockets, hands behind the back, gloves, nails, a ring, genitals, urine, a wallet chain, a shoe belt, shoe accessories, cowboy spurs, feet and toes as a whole, wings, a tail, multiple human figures, an animal, colors used, and a frame around the human figure. An inter-rater agreement of 100% was also found for 4 items (3% of all noted items) which were only present in the drawings of non-gifted children. Those involved: a nose piercing, knees, shoe zippers and perfectly straight lines (as if a ruler has been used).

In the drawings of the highly gifted group, each of the 30 ‘exceptional’ items occurred only once or twice. Also, 20 (43%) of the highly gifted children drew one or more exceptional items (21% drawing 1 item, 11% drawing 2 items, 4% drawing 3 items, 4% drawing 4 items and 2% drawing 5 items). So, on the basis of exceptional items, 43% of the highly gifted children could be identified correctly.

To determine whether or not the mean drawing-IQs of highly gifted children who drew one or more exceptional items and highly gifted children gifted children who drew no exceptional items differed significantly from each other, an independent *t*-test was performed, exceptional items drawn (or not) being the independent variable. For both the GHDT and the DAP:QSS, the results show no significant differences in drawing-IQs of highly gifted children who drew one or more exceptional items and highly gifted children who drew no exceptional items (see Table 3).

Table 3
Comparison of Drawing-IQs of Highly Gifted Children Who Drew No Exceptional Items and Highly Gifted Children Who Drew One or More Exceptional Items

		GHDT		DAP:QSS			
Exceptional item group	*n*	*M*	*SD*	*M*	*SD*	*t*	*p*
0 exceptional items	27	103.56	14.84	96.04	15.48	-0.68	.503
≥ 1 exceptional items	20	106.95	19.67	97.20	18.42	-0.24	.815

Note. M = Mean drawing-IQ score. *SD* = Standard Deviation.

Of the children who achieved a GHDT drawing-IQ score of 130 or more, 4 children (2 non-gifted, 2 highly gifted) drew 0 exceptional items, 1 child (highly gifted) drew 1 exceptional item, 1 child (highly gifted) drew 2 exceptional items and 1 child (highly gifted) drew 3 exceptional items. Of the children who achieved a DAP:QSS drawing-IQ score of 130 or more, which involved only highly gifted children, 1 child drew 0 exceptional items, 1 child drew 2 exceptional items and 1 child drew 3 exceptional items.

To determine (within the highly gifted sample) whether children who achieved a drawing-IQ of 130 or more drew exceptional items significantly more often than children who achieved a drawing-IQ below 130, Fisher's Exact tests were performed. The results showed no significant differences for the GHDT, $X^2(1, n = 47) = 0.70$, $p = .638$, nor for the DAP:QSS, $X^2(1, n = 47) = 0.76$, $p = .567$.

Discussion

The results regarding whether or not highly gifted and non-gifted children can be identified by their drawing-IQs, show that there were no differences between drawing-IQs of these two giftedness groups when using the GHDT or the DAP:QSS. The two-way ANOVAs show that girls score higher than boys on both the GHDT and the DAP:QSS; this is found in both giftedness groups.

The results show that, when analyzing drawing-IQs, the GHDT is not a good instrument to identify young highly gifted children based on their HFDs; highly gifted and non-gifted children did not draw differently. This confirms the conclusions of studies that led investigators to advise against the use of HFDs to estimate intelligence (Abell et al., 2001; Imuta et al., 2013; Lilienfeld, Wood, & Garb, 2000; Willcock et al., 2011).

Girls score higher than boys on the GHDT. This seems to support existing literature, which suggests that girls of a certain age have developed relatively further than same-aged boys (see Halpern, 2012; Harris, 1963; Koppitz, 1968). However, the GHDT uses different norms for boys and girls. If this were not the case, the higher drawing-IQs of girls compared to boys would not be surprising, but now it is. Given the results found in the present study, it cannot be ruled out that the GHDT norms from 1963 (Harris, 1963) are outdated and no longer reliable. In fact, the GHDT results give a clear indication of a Flynn effect for girls, but – remarkably – not for boys.

The scores of the DAP:QSS show similar results to the scores of the GHDT in that there were no significant differences in drawing-IQs of highly gifted and non-gifted children. On the other hand, over 6% of the highly gifted children and none of the non-gifted children scored 130 or higher on the DAP:QSS, and over 6% of the highly gifted children scored higher than the highest score of the non-gifted children. Furthermore, on the DAP:QSS, girls again scored higher than boys. The explanation of outdated norms may also apply here, since norms for the DAP:QSS were standardized in 1988 (Naglieri, 1988). Whether or not girls develop faster compared to 25 years ago and whether this can be given as an explanation, cannot be stated based on the present literature. The DAP:QSS results give some indication of a Flynn effect for girls, but not for boys; boys scored far below 100.

Concerning the overall scores as computed by the GHDT and DAP:QSS, it can only be concluded that instruments for computing drawing-IQs from HFDs cannot be used to identify highly gifted children, since the scores of highly gifted children and non-gifted children do not differ significantly.

When examining the drawings on item level, however, many items were only shown in the drawings of highly gifted children. Some other items were only drawn by non-gifted children. This observation shines a new light on the drawings of highly gifted children, because these differences cannot be noticed when analyzing drawing-IQs. Drawing-IQs result from a total sum score and do not give any information about the particular items that have been drawn, let alone 'exceptional' items. The results even suggest that there is no association between a high drawing-IQ and drawing exceptional items. Therefore, it is recommended that HFDs are analyzed on item level in future studies, in which the focus should be on cross-validation.

Thirty exceptional items, which may indicate giftedness when analyzing HFDs, were found. However, these items only occurred once or twice within the whole sample. The same applies to the four items which were only present in the drawings of non-gifted children. Whether or not the found items are valid (contra)indications of giftedness remains unclear. The nature of the exceptional items goes beyond the drawing of a mere human figure; without the presence of the exceptional item(s) in the drawing, the figure drawn would still be human.

With this observation, the hypothesis that highly gifted children produce more novel drawings when compared to non-gifted children because of their creativity (see Piirto, 2005) is supported. The occurrence of certain items may be caused by the environment of the children; for example, a child who draws a bearded man, may know someone who has a beard. This suggests that the environment is highly important for potential to be developed in achievement, as stated in many models and theories on giftedness (e.g. Gagné, 2004; Heller, 2004; Mönks & Pflüger, 2005). Further research on exceptional items is needed to clarify this matter. It is also important to note that those exceptional items were present in approximately half of the HFDs of highly gifted children. So, although detection is much better when based on exceptional items (43%) than when based only on drawing-IQ (6.4%), there remain many false negatives using this item level analysis.

At this stage of the research, it would be wise to treat the exceptional items as individual expressions of highly gifted children; every child seems to have her or his own unique expression. In addition, for identification purposes, future research should examine whether the occurrence of multiple exceptional items may indicate giftedness. It is also possible that some redundant items (items that are added to the drawing, but are not necessary for a human figure) may result from, for example, playfulness, love of details or not being adequately challenged. Whether or not this is the case, can be found with the help of instruments other than HFDs. Future research should take this into account.

The present study shines a new light on the capacities of highly gifted children. Research has shown that cognitive capacities and possibly social-emotional development of highly gifted children exceed the age-appropriate range (Robinson, 2004; Southern & Jones, 2004). This developmental advantage does not appear in drawing-IQs, in the present study.

The assignment of children to the giftedness groups for the present study was dependent on the form of education they received. Children from Leonardo-education were classified as highly gifted and children from regular education were classified as non-gifted, unless there was suspicion of giftedness. This seems quite legitimate, because a total IQ of 130 or higher is required to enter Leonardo-education, and diagnosed children from regular education were excluded. False negatives within regular education – classified as non-gifted, but actually being an undiscovered highly gifted child – cannot be ruled out, however. A good example of such a highly gifted student is the underachiever, as mentioned in the Introduction. Whether or not these children are involved in the present study, is unclear.

The absence of an investigator during the drawing task is an asset and a weakness at the same time. The absence of an investigator guarantees a class environment with which the children are familiar. But without the presence of an investigator, extraneous variables (such as a teacher walking through class) cannot be controlled. It is not clear whether factors as mentioned above have had a significant influence on the results of the present study. It is recommended that future studies ensure an investigator is present to observe what happens in class, but his or her presence should not influence the way children draw.

The results of the present study lead to other research questions. A question that concerns the capacity of highly gifted children is: if highly gifted children have an advantage in development – social-emotionally or cognitively – why are there no differences in drawing-IQs of highly gifted and non-gifted children? A possible explanation may be that small effects are prone to sampling fluctuations. Another explanation may be found in the artistic skills of the participating children, and their awareness of it. At the consulting practice of the CBO, it is often noticed that highly gifted children do not like to draw, because they are not able to perfectly express the image they have in their mind on the paper. Gifted children are known to be prone to perfectionism (e.g. Fong & Yuen, 2014; Roberts & Lovett, 1994; Silverman, 2007) and to avoid risks if they think they will not achieve perfection (Betts & Neihart, 1988; Neihart & Betts, 2010). This causes a lot of children to quickly draw something in order to finish the task as soon as possible. This may cause them to produce less detailed drawings than those of which they are capable. Although there seem to be no indications for this in the present study (teachers did not mention anything related to the speed of completion of the drawings), it would be unwise to not take this possibility into consideration. In future studies, it is recommended that possible differences in speed of completion are recorded to get more insight in this matter. If possible, perfectionism should be ruled out as a confounding factor when analyzing HFDs.

Finally, the findings of the present study concerned the drawings of children in the age range of 7 to 9. Children within this age span have been at school for at least a couple of years. It is known that when children enter (pre)school for the first time, they encounter challenging situations for which they need to adapt and conform to what is being expected of them (McDermott, Watkins, Rovine, & Rikoon, 2013). Teachers often value socially important characteristics, such as obedience and courtesy (Lubart et al., 2009). In addition, Guignard and Lubart (2007) have found that at age 10, highly gifted children are able to think significantly more divergently than non-gifted children, but no differences in divergent thinking are found between the two groups at age 12. Although this applies to older children than the children who participated in the present study, these findings connect to what is often reported by parents who visit the CBO: the drawings of their children changed after they entered primary school. At home, the children drew remarkably detailed drawings, but at school, the drawings looked exactly like the more simple drawings of their classmates. This may have been obstructive in the goal to find exceptional items that may serve as indicators for giftedness. Future research should therefore focus on the drawings of preschool children, before their drawings may be negatively influenced by school setting, teacher(s) and/or classmates. Research on giftedness in the first few years of childhood may also be valuable, because this concerns a period in which very little is known about giftedness (Simonton, 2009) and no provisions for identifying or developing giftedness have been made (Koshy, 2009).

Therefore, a goal of future research should be to investigate if preschool and early school-age highly gifted children also draw items that do not occur in the drawings of non-gifted children. It may also be wise to investigate in future studies if the same items, other items or occurrence of multiple exceptional items can be considered indicators for giftedness. In addition, valuable information can possibly be found in 'formal items' (Harris, 1963; Janssen, 1970; Naglieri, 1988) and 'emotional indicators' (Koppitz, 1968, 1984), such as the proportions of the drawn items. The present study focused entirely on the actually drawn items, but not specifically on how the items were drawn. Perhaps paying attention to these factors will uncover more or clearer differences between the drawings of highly gifted and non-gifted children.

There are some confounding factors that should be controlled for in future research. For example, different school environments and personal backgrounds of the participating children should be taken into account. To be more conclusive about the results, these confounding factors should be ruled out and manipulation checks on the authenticity of the procedure and checks to confirm possible giftedness or ASD should be completed.

The outcome of the present study justifies a more extensive research program, which has already been started. To begin with, a replication study with 7 to 9 year olds is being undertaken, to be followed by a study with 4 to 6 year olds. At the same time, an effort is made to develop a more detailed theoretical framework; this is not an easy task, because it has to be based on the development of children in different areas. This program should result in a well-founded diagnostic screening instrument: a stepwise scoring system of exceptional items in HFDs, with which highly gifted children can be more easily detected in diagnostic assessment at an early age.

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The Authors

Mr Sven Mathijssen is currently a developmental psychologist at the Center for the Study of Giftedness (CBO), teacher for ECHA-Specialists in Gifted Education at Radboud University, and external PhD candidate at Tilburg University. In his doctoral research program, he analyzes human figure drawings (HFDs) of highly gifted children. His goal is to develop a screening instrument for analyzing HFDs, with which highly gifted children can be more easily detected in diagnostic assessment at an early age.

Max Feltzer, PhD is a developmental psychologist, researcher and teacher at Tilburg University, Tilburg, The Netherlands (Department of Developmental Psychology). His research interests involve children's drawings, cognitive and social-emotional development. Dr. Feltzer has more than 40 years experience in these areas, and is currently working on several large-scale research projects involving construction of new psychological screening instruments to assess rate of development in children aged 0 to 12.

Dr Lianne Hoogeveen is developmental psychologist and program director of the post-academic training for School Psychologist and program director of the post-academic education (ECHA training), both at the Radboud University Center for the Study of Giftedness (CBO) of the Radboud University in Nijmegen, the Netherlands. She is member of the General Committee of the European Council for High Ability (ECHA). Lianne Hoogeveen is teacher of Pedagogical and Educational Sciences at Radboud University and guest teacher in several other European universities. She is involved in scientific research on giftedness and education in cooperation with colleagues of other universities, in- and outside the Netherlands.