Children Gifted in Drawing: Underlying Perceptual Strengths

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To create a drawing that appears to be a realistic representation of a scene is a complex task. Contrary to what you might think, a realistic drawing does not copy information from the world onto paper: even the most highly naturalistic drawing is both a simplification and a distortion (Gibson, 1979; Gombrich 1960; Gregory, 1997; Kennedy, 1974). It is not possible to transfer the infinite gradations in color and light and the enormous array of detail in our three-dimensional visual world onto a two-dimensional surface. This means that the artist must omit much information. It also means that when drawing realistically, the artist must distort in order to convey the illusion of realism. Take the example of a table-top. We know it is rectangular, but the realist draws it as a trapezoid – with lines that converge – so that the distorted table top will convey the illusion that it recedes into depth. Thus realistic artists draw what they see (a trapezoid for a table top), not what they know (a rectangle for a table top, which is its actual shape). It is actually hard to train ourselves to see accurately because our knowledge intervenes: when we look at that table top, it looks like rectangle because we know it is one. The artist learns to overcome this and see it as a trapezoid.

Individuals differ in their ability to draw realistically and these differences can be seen in early childhood, prior to any formal instruction (Golomb, 1992; Milbrath, 1998; Winner, 1996). Some children, whom we like to call precocious realists, are able to draw far more realistically than their peers, and they do so even though they have never attended an art class where they are taught the tricks of the trade – i.e., methods to get the eye to see that table top as a trapezoid. Here we describe some of the characteristics of
drawings by precocious realists and then present some new findings about the perceptual strengths exhibited by such children. Surprisingly, we see these same perceptual strengths in children diagnosed with autism spectrum disorder who are able to draw in a hyper-realistic fashion.

**Characteristics of Drawings by Non-Autistic Precocious Realists**

*Graphic Representation, Not Action Representation*

While typical children begin to draw recognizable shapes representing objects in the world at around the age of three or four (Golomb, 1992; Kellogg, 1969; Matthews, 1984), some children produce their first representational drawings at the age of two. And the first representational drawings are typically “action representations” (Matthews, 1984). For example, a child might draw a slash across the page and then say “truck crashing.” The line does not look like a truck, but the child makes the line with a swift crashing motion. In contrast, early representational drawings by precocious realists are “graphic representations:” you don’t need to watch the child draw or hear the child’s label to know what the picture represents because the picture says it all.

*Line as Contour or Edge*

While typical children first use line in their representational drawings to stand for “thingness,” precocious realists use line to indicate contour or edge. Thus a typical child might represent an apple with one slash of a line -- the same line that might also stand for person or car. Any line represents anything. But a precocious realist will represent an apple by drawing a rounded line that actually captures the rounded contours of an apple.
**Differentiated Shape**

At a very young age, precocious realists understand how objects are structured. Drawings of the human figure provide a good example. The typical three-year old represents a human as a circle with eyes and four lines emanating out of the circle (the arms and legs). This is commonly referred to as a tadpole figure. Precocious realists at the same age are able to depict the human figure with the major body parts differentiated: head, neck, torso, and limbs extending from the torso.

**Illusion of Depth**

The drawings of precocious realists capture the illusion of depth and volume. These children often invent perspective on their own, even if the perspective they come up with is not precisely correct. Eitan, a three-year old child studied by Golomb (1992), represented the third dimension by parallel oblique lines. Thus, he resisted the temptation to depict the shape of a table top receding into depth as a rectangle (its actual shape) and instead drew it as a parallelogram. This kind of perspective is not optically correct: the correct depiction would show receding edges as converging rather than parallel. Still it is an advanced solution, one not arrived at by typical children until late childhood.

*A Comparison between Drawings of Gifted Children with and without Autism Spectrum Disorder*

Children diagnosed with Autism Spectrum Disorder (ASD) are sometimes capable of extraordinarily realistic drawings and some show even greater drawing skill than do typical children gifted in drawing. Savants are individuals with autism or mental retardation as well as one area of extreme skill – typically in music, calculation, or realistic drawing. Savant drawings are hyper-realistic, just like the drawings by typically
developing precocious realist children (Mottron & Belleville, 1993; Pring, Hermelin, & Heavey, 1995). The drawings by an artistic savant named Nadia (Selfe, 1977; 1983) made at ages three and four are probably more realistic than those of non-ASD precocious realists at the same age. (OPTIONAL: INSERT FIGURE 1 HERE).

It has been argued that the hyperrealism of savants is due to their inability to form concepts. Hence when they draw a chair they do not draw some generic simplified kind of chair but rather a particular chair in all its detail (Pariser, 1981). However, given that hyperrealism is found in some typically developing children as well, it seems more parsimonious to conclude that savants have the same kind of drawing talent as do precocious realists. Apparently this kind of talent can exist independently of normal intelligence and of normal social skills (since these are deficient in individuals with ASD).

Artistic savants have an unusual perceptual skill: they can look at a complex image and analyze it -- segmenting mentally it -- into its parts (Pring et al., 1995). This ability has also been reported in studies of ASD individuals not selected for drawing talent (Caron, Mottron, Berthiaume, & Dawson, 2006; Shah & Frith, 1983, 1993). It has been argued that this “local processing bias” could be part of the explanation for their amazing ability to draw realistically (Mottron, Dawson, Soulieres, Hubert, & Burack, 2006). This led us to wonder whether the typically developing children whom we call precocious realists also have this skill.

We studied a group of 27 typically developing (i.e., non-ASD) children ranging in age from six to 12 (Drake, Redash, Coleman, Haimson, & Winner, 2010). We gave them a drawing task that allowed us to place each child along a continuum of drawing giftedness, and then we gave them all two tasks that called for local processing. We also asked
parents questions to indicate the number of years of formal art training their child had had. Our research question was whether those more gifted in drawing realistically would be better at mentally segmenting complex images and detecting figures hidden in a complex figure. We also wanted to find out if precocious realists share any behavioral traits with children with ASD, and thus asked parents to fill out a standard questionnaire assessing ASD traits.

In order to assess level of drawing talent, we asked children to draw a still-life from observation. The still-life was difficult to draw: it consisted of two complex objects - a corkscrew and a vase made up of six connected transparent cylinders, one of which contained a stalk of dried leaves. We scored children’s drawings for level of realism using a detailed scoring system that we have shown to be both valid and reliable (Drake et al., 2010). Children received a score from 0.0 to 1.0 to indicate the proportion of times they used techniques that have been reported typical of gifted children’s drawings.

(OPTIONAL: INSERT FIGURE 2 HERE).

Next we gave children two tests that assessed a local processing bias. The first was the Block Design Task modified by Caron et al. (2006). Children were shown a red and white pattern and were asked to recreate this pattern using blocks: some sides of the blocks are white, some red, and some red and white. We presented this task in two ways. In the unsegmented version, the patterns do not reveal their internal parts. Hence this version requires mental segmentation in order to reconstruct the pattern with blocks. In the segmented version, the parts are separated from one another spatially. Hence, this version requires no mental segmentation since the part are already externally segmented.

(OPTIONAL: INSERT FIGURE 3).
Individuals with ASD perform equally well on both versions of the task, while typical children (those without drawing talent) perform better when the images are externally segmented (Shah & Frith, 1993). We wanted to find out whether typical children with drawing talent performed like those with ASD. The items also varied in perceptual cohesiveness. In the minimally cohesive items, the block-size components of the design are opposite in color which is a form of external segmentation. In the maximally cohesive items, the block size components of the design are the same color and thus these items lack any kind of external segmentation cues when presented in the unsegmented form. These are of course the most difficult items. Individuals with ASD do better than those without ASD on the maximally cohesive items -- showing their ability to mentally segment these complex images (Caron et al., 2006). We sought to determine whether non-ASD children with drawing talent perform like the ASD individuals in Caron et al.’s study.

For our second test of a local processing bias we used the Group Embedded Figure Test (Witkin, Oltman, Raskin, & Karp 1971). Children were asked to identify a simple shape embedded within a larger figure. Here one must avoid the overall context and focus on the details. Individuals with ASD excel at finding shapes embedded in complex figures (Edgin & Pennington, 2005; Jolliffe & Baron Cohen, 1997). We thought it likely that non-ASD children with drawing talent would perform like ASD individuals on this task.
Our findings were very clear. All of the results we report here were unrelated to age and number of years of formal art lessons (and also independent of verbal IQ, as we discuss later). We first calculated a Block Design segmentation difference score for each child by subtracting the score on the segmented items from the score on the unsegmented items. Level of drawing skill predicted the segmentation difference score. In other words, children with greater drawing skill were less helped by segmentation than were those less gifted.

The segmentation difference score included items at all three levels of perceptual cohesiveness. Since items at the lowest level of perceptual cohesiveness should be unaffected by presentation in segmented version, we next created a segmentation difference score for the most difficult items by subtracting the maximally segmented items from the maximally cohesive unsegmented items. Level of drawing skill predicted the maximally cohesive difference score. Precocious realists showed their ability to mentally segment by the fact that their performance was not impaired when they had to copy designs of high perceptual cohesiveness. Here again, precocious realists performed like individuals with ASD and like artistic savants (Caron et al., 2006; Mottron et al., 2006). They do not need the external segmentation because they are able to mentally segment.

The same conclusion could be drawn from performance on the Group Embedded Figure Test. We examined whether drawing skill predicted accuracy on the Group Embedded Figure Test. Level of realism predicted skill at finding simple shapes embedded in complex figures with greater accuracy. Thus, the ability to draw realistically is related to the ability to avoid the context effect and find the details in a whole.
It might be considered surprising that a talent for drawing realistically is associated with superior performance on the Block Design Task and the Group Embedded Figures Test. After all, matching a two-dimensional picture with a two-dimensional pattern of blocks is quite different from translating a three-dimensional still-life into a two-dimensional surface representation (as was required by the still life drawing task). And detecting a shape hidden in a complex figure is very different from observing a three-dimensional still-life and creating a two-dimensional representation. However, these tasks and the task of drawing realistically require that one look carefully at the model and analyze it into its component parts. Our research suggests that precocious realists use their visual analysis skills to create a realistic two-dimensional representation of a three-dimensional model.

Could the superior drawing skills of our precocious realists be a function of IQ? Were the gifted drawers more “intelligent” and thus better able to perform on Block Design Task and Group Embedded Figures Test? One reason to suspect that this would not be true is that artistic savants have low verbal IQ, demonstrating that drawing skill is independent of verbal IQ. To find out, we administered the verbal section of the Kaufman Brief Intelligence Test-II (Kaufman & Kaufman, 2004) to the children in our study. The verbal section consists of two parts, a vocabulary test in which pictures of objects must be named, and a definitions test in which participants must decipher a word after hearing its definition along with the word partially written but missing some letters. Our results showed that drawing skill and verbal IQ were unrelated: level of drawing score did not predict level of verbal IQ. And, verbal IQ was unrelated to performance on the Block Design Task or Group Embedded Figures Test. Thus the answer to whether drawing skill
is independent of verbal IQ is an unqualified yes, at least in typical children and in individuals with ASD!

Since our precocious realists performed like individuals with ASD on our tests, and since their gift was independent of verbal intelligence just as in the case of artistic savants, it could be that our precocious realists were mildly autistic. We were quite certain that they were not on the basis of our interactions with these children, but we needed to rule out this possibility. We asked parents to complete the Child Asperger Syndrome Test (CAST), a questionnaire that assesses ASD-like traits. Questions on the CAST can be grouped into three subscales: Social Impairments (does not make appropriate eye contact), Communication Impairments (has odd or unusual phrases), and Restricted Repetitive Behaviors and Interests (noticing unusual details that others miss).

As we suspected, we found no relation between drawing giftedness and overall score on the CAST. But when we looked at each subscale, we found something interesting. The Restricted and Repetitive Behaviors and Interests subscale was related to drawing skill. The higher the scores on this subscale, as reported by parents, the higher the scores in drawing skill. Perhaps this finding is not so surprising. These kinds of traits are not pathological at all; rather, they are strengths that contribute to drawing talent.

What we have presented here is, to our knowledge, the first evidence that the superior visual and spatial abilities found in individuals with ASD -- even those without any talent or experience in drawing -- are also characteristic of typically developing children who are gifted at drawing realistically from observation. These precocious realists resemble ASD children in their perceptual talents (as shown by how they perform on our tasks, and as shown by parents' reports of their repetitive behavior and interests)
despite the fact that our precocious realists were not autistic in any sense. And recall that these results were found independently of age, years of art lessons, and verbal IQ.

We can conclude that heightened visual analysis skill is associated with precocious drawing ability, just as it appears to be associated with ASD. We are now investigating whether the heightened visual analysis talent that has been reported to be a function of ASD might actually only be found in ASD individuals who also have a talent for realistic drawing.
References


Figure Captions


2. Still-life model and drawings by two 10-year olds, one with a drawing score of 1.0 and (left) and one with a drawing score of 0.0 (right).

3. Minimally (left) and maximally (right) cohesive block design in unsegmented and segmented versions.