Perception, 2009, volume 38, pages 000 – 000

doi:10.1068/p6449

LAST BUT NOT LEAST

Drawing the line: How people with autism copy line drawings of three-dimensional objects

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Received 24 April 2009, in revised form 5 June 2009

Abstract. It is purported that the local perceptual style characteristic of those with autism results in them reproducing line drawings in a more localised manner than comparison individuals. Here we report an exception to this: the drawing strategies of those with autism were more global. When reproducing line drawings depicting three-dimensional objects, a sample of fifty-six participants with autism showed a greater tendency to begin by copying the two-dimensional outline of the figure than fifty-seven matched comparison participants (39.3% versus 8.8% of group; $\chi^2_1 = 14.46$, $p < 0.0005$). We argue that this is consistent with the perception of those with autism being less conceptually driven, but not necessarily less global.

The idea that perception is more localised in individuals with autism than in those without the condition forms part of two influential theories of perceptual processing in autism [weak central coherence—Happé and Frith (2006); enhanced perceptual functioning—Mottron et al (2006)]. It has been suggested that, as a consequence of their local perceptual style, we might expect to see a higher frequency of localised drawing strategies amongst individuals with autism when copying line drawings. Hence, whereas typical individuals frequently begin with the outline, those with autism may be more likely to start with internal details (eg Mottron et al 1999).

However, the drawing strategy in individuals of typical development can also be influenced by certain conceptual factors (eg Vinter 1999). One situation where this influence might be apparent is when the line drawing in question depicts a three-dimensional (3-D) object. For example, the line drawing of a cube in oblique projection in figure 1 includes parallelograms for the top and side faces, a pictorial convention that gives the impression of depth. For such drawings, it seems probable that a strategy which takes into account the 3-D structure of the object in the picture would be adopted, rather than a strategy that follows the two-dimensional (2-D) outline of the figure. Indeed, characteristic errors in drawings of cubes by typically developing children reflect their tendency to draw each face as an isolated unit based upon a 3-D structural description of the object depicted (Bremner et al 2000). For example, it is common for all the faces to be drawn as squares at right angles to one another, indicative of knowledge of the 3-D properties of the object depicted.

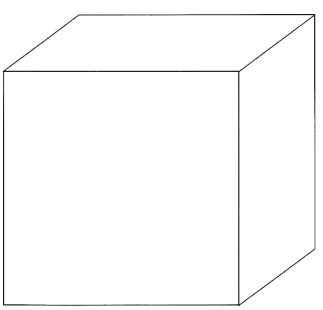


Figure 1. Cube in oblique projection.

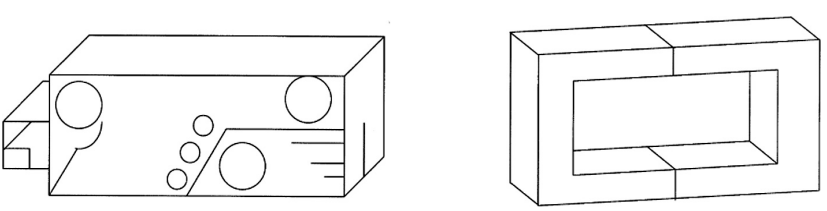
In contrast, in three previous studies, we noted that participants with autism showed a distinct tendency to reproduce line drawings that depict 3-D objects by first copying the 2-D outline of the figure, before proceeding to copy the internal features. Here we report data combined from three experiments (Sheppard et al 2007, 2009a, 2009b), which yielded a sufficient sample size to investigate factors contributing to the use of this strategy.

Data were collected from a total of fifty-six participants with autism and fifty-seven comparison participants (who did not have a diagnosis of autism) for the three experiments. As three participants with and three without autism participated in more than one of the studies, these individuals were included only once in the data set, but their performance in both experiments was taken into account. In each of the three studies, participants with and without autism were matched in terms of their verbal, performance, and full-scale IQ, as well as chronological age. As some of the participants with autism in these studies had developmental delay, the comparison group also included some individuals with learning difficulties. Those with developmental delay without autism were excluded if they were reported to have any features of autism in their Statements of Special Educational Needs, which detail symptoms associated with their diagnoses by a trained clinician. None were diagnosed with a specific neurodevelopmental disorder or genetic syndrome (eg aphasia, fragile-X). Table 1 provides a summary of these details for the two groups for the studies combined. These two composite groups did not differ significantly on any of the variables (all ps > 0.24).

Table 1. Participant details.

	Verbal IQ	Performance IQ	Full-scale IQ	Chronological age/years	Gender, M : F
Autism					
mean	71.77	83.16	75.71	12.66	43 : 13
SD	13.13	14.02	10.40	2.43	
range	54 – 101	58 – 125	56 – 101	6.83 – 18.25	
Comparison					
mean	74.68	82.51	76.93	12.38	40 : 17
SD	13.04	16.49	14.10	2.47	
range	55 – 110	57 – 126	54 – 112	7.08 – 16.92	

Although the figures to be drawn differed in each of the three experiments, all required the participant to copy a number of line drawings depicting 3-D objects (see figure 2 for examples). Whilst the participant made his/her copy, the experimenter repeated his/her sequence of movements exactly (creating a copy of the copy) and numbered the lines in the order in which they were drawn, for later analyses of drawing strategy. Here, participants were coded in terms of whether or not they used this outline strategy for copying any line drawing of a 3-D object. In each case, to be regarded as having used the outline strategy, it was necessary for the participant to have drawn all of the 2-D external contours of the line drawing prior to copying any internal line.



(a) (b)

Figure 2. Examples of line drawings from (a) Sheppard et al (2007) and (b) Sheppard et al (2009).

Twenty-two (39.3%) participants with autism used the outline strategy, in comparison with five (8.8%) participants without the condition. A χ^2 cross-tabulation showed that participants with autism used the outline strategy more frequently than comparison participants ($\chi^2_1 = 14.46$, $p < 0.0005$). Further, a logistic regression was used to investigate which factors significantly predicted the use of the outline strategy. Although the groups were matched on age and IQ, there was considerable variability within both groups in these factors, making it possible that they related to the use of the outline strategy. A stepwise forward regression with the likelihood ratio statistic was used, with participant diagnosis, gender, verbal, and performance IQ entered as predictors. Of these, only participant diagnosis was a significant predictor of using the outline strategy (Walde statistic = 12.53, df = 1, $p < 0.0005$). The odds of using the outline strategy increased by a factor of 6.73 if the participant had autism.

These results suggest that, contrary to predictions of weak central coherence, those with autism do not consistently use more localised drawing strategies than comparison individuals. Line drawings of 3-D objects represent an interesting case, as the global properties of the drawing when considered as a 2-D array of lines differ from the global properties of the object depicted, which will include some of the internal features. These findings are accordant with research that implies that the perception of those with autism is less concept-driven (eg Ropar and Mitchell 2002; Soulières et al 2007), as it seems that those with autism have a tendency to disregard the properties of the 3-D dimensional objects depicted in the drawings. Perception that is less affected by higher-order or top–down influences forms part of the enhanced perceptual functioning model (Mottron et al 2006), in addition to a propensity to process more locally. The results here suggest that, when these two aspects of autistic perception are in conflict, the tendency to be less affected by concepts may take precedence. Ironically, this may lead individuals with autism to use a strategy that is more 'global' than that characteristically adopted by those without the condition.

Acknowledgments. We are grateful for the kind cooperation of the staff, parents, and students who participated in this research. This research was supported by an Economic and Social Research Council studentship awarded to the first author. We would also like to thank Laurent Mottron and Daniel Acquah for their thoughtful comments on the manuscript.

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