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BRIEF REPORT

Brief Report: Decoding Representations: How Children with Autism Understand Drawings

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Abstract Young typically developing children can reason about abstract depictions if they know the intention of the artist. Children with autism spectrum disorder (ASD), who are notably impaired in social, 'intention monitoring' domains, may have great difficulty in decoding vague representations. In Experiment 1, children with ASD are unable to use another person's eye gaze as a cue for figuring out what an abstract picture represents. In contrast, when the participants themselves are the artists (Experiment 2), children with ASD are equally proficient as controls at identifying their own perceptually identical pictures (e.g. lollipop and balloon) after a delay, based upon what they *intended* them to be. Results are discussed in terms of intention and understanding of visual representation in autism.

Keywords Drawings · Representation · Intention · Symbols

Psychologists have long emphasized the importance of children's drawings and competence with pictures during development (Gardner 1980; Freeman 1980; Cox 1992; DeLoache 2004). Individuals with autism spectrum disorder (ASD) readily produce drawings, but little is known about how they understand the symbolic link between a drawing, referent, and the person who creates the depiction. Abstract or ambiguous drawings may be particularly difficult to decode since one cannot rely on the physical appearance of the picture, but must understand the intention of the artist to decipher the depiction (Bloom 2000). Thus, investigating how children with ASD produce and understand *abstract* drawings can provide crucial information about their mental representations and symbolic understanding.

Drawing skills of children with ASD appear to be unimpaired relative to age-matched typical peers (Charman and Baron-Cohen 1993; Eames and Cox 1994), although differences are evident in drawing style. Children with ASD produce an overlap in pictures of humans but not non-humans (Fein et al. 1990), and have difficulty producing distinctive drawings of humans, but not houses (Lee and Hobson 2006). There are also differences in imagination expressed in drawings, reflected by the difficulty children with ASD have drawing 'impossible' figures like a 2-headed man (Leevers and Harris 1998).

Regarding picture perception, children with ASD perform like typically developing peers in certain tasks, including interpreting ambiguous figures and visual illusions (Ropar et al. 2003; Ropar and Mitchell 2001). Children with ASD surprisingly outperform typically developing preschoolers on false drawing tasks, which requires children to remember their own mental state (Peterson 2002). This interesting result, however, does not address how children with ASD reason about abstract pictures drawn by others.

Typically developing children easily use intentional cues such as eye gaze and naming in order to figure out what an abstract picture is supposed to depict (Bloom and Markson 1997; Preissler and Bloom 2008). Similarly, they can recognize their own seemingly indistinguishable

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depictions based upon what they meant them to be, even if a naïve viewer cannot tell them apart (Bloom and Markson 1998). Intention, then, seems to be an integral part of understanding visual depictions.

Individuals with ASD show impairments in understanding their own and others' intentions (Baron-Cohen et al. 1985; Baron-Cohen 1995). If monitoring intentions is required for decoding abstract representations, children with ASD should have difficulty decoding drawings produced by themselves and others. Alternatively, decoding one's own pictures may be easier than reasoning about ones produced by another artist. Thus, two studies ask: (1) Can children with ASD decode another person's abstract drawings? (2) Can they decode their own pictures after a delay? Overall, this research investigates how children with ASD understand the symbolic relationship between a picture and its referent.

Participants

In both studies, 16 children clinically diagnosed with Autism Spectrum Disorder (ASD) according to DSM-IV criteria participated (15 = Autism, 1 = PDD). Children were recruited from and tested at the Kaimes School in Edinburgh, a school for children with ASD. Clinical diagnosis was confirmed with the Social Communication Questionnaire (Rutter et al. 2003), (mean score 26.3, range 18–38, all well in ASD range). Half of the participants with ASD were mentally retarded (mean IQ = 63, range 40–71), as determined by a score <75 on the Kaufman Brief Intelligence Test (K-BIT; Kaufman and Kaufman 1993) and half were within normal cognitive functioning range (IQ = 90.8, range 78–102). The mean chronological age was 9.3 years (range, 6.1–11.6) and mean receptive language assessed by the British Picture Vocabulary Scale (BPVS; Dunn et al. 1997) was 4.5 years.

Typically developing children matched on receptive language ability were also included ($N = 16$, mean language = 4.4 years).

Experiment 1

Method

Materials

The stimuli were: a pencil, crayon, fork, and spoon and two pre-drawn pictures constructed to equally represent a fork or spoon, and a crayon or pencil. In a pilot study, adults confirmed that the abstract drawings could equally resemble either of the objects.

Procedure

All sessions were conducted in a private room. Based upon Bloom and Markson (1997), children watched as an experimenter placed a fork on one side of a table and a spoon on the other. The experimenter grabbed a clipboard and turned towards one of the items, pretending to draw the object. It was readily observable which object the experimenter was looking at. Unbeknownst to participants, the drawing was pre-made to equally resemble both objects. The task was simple—the children were immediately asked to name the depiction (e.g. 'What is this?'). Children received two trials (fork/spoon and pencil/crayon) counterbalanced for order and position on the table.

Scoring

Responses were coded as: the object the experimenter was looking at, the distracter object, or 'other' (naming the picture something other than one of the objects on the table, for instance calling the pencil/crayon a 'line').

Results

Typically developing children named the picture according to where the adult was looking. They selected the object the experimenter was looking at 75% of the time (24/32 trials), the distracter object 18.8% (6/32), and named the picture something other than either object 6.2% (2/32), which differs from chance performance of 33% ($\chi^2 = 25.74$, $p < .0001$, df = 2). In contrast, children with autism selected the object in the experimenter's line of sight 25% (8/32), the distracter object 37.5% (12/32), and named the picture something other than either object 37.5% (12/32), which does not differ significantly from chance performance ($\chi^2 = 1.00$, $p = .61$, df = 2). The groups differed significantly from each other ($\chi^2 = 66.67$, $p < .0001$, df = 2).

Interestingly, the children with ASD were more likely to produce 'other' responses, naming the picture according to what it looked like ("that's a funny fork", even if the drawing was meant to represent a spoon, or "that's a line", when naming the picture of the crayon or pencil), suggesting that they are not taking into account what the artist was *intending* to represent, but focusing instead on the appearance of the picture itself. Typically developing children, in contrast, linked the picture to one of the objects.

Thus, children with ASD do not necessarily link a picture drawn by another person to its real world referent, but analyze the pictures based upon their appearance. Experiment 2 asks whether children with ASD are more likely to interpret their own pictures as symbols for real world referents.

Experiment 2

Method

Materials

The stimuli consisted of blank sheets of A4 paper and crayons.

Procedure

In this study, children were asked to draw a balloon, lollipop, the experimenter (female) and the child's mother. Each drawing was produced on a separate sheet of paper with a different colored crayon, and then placed out of the child's view. After a delay of 15 min, during which children did an unrelated task, the experimenter 'found' the drawings and asked children to name the depictions.

Results

An independent rater classified children's drawings as 'balloon', 'lollipop', or 'either' (see Fig. 1), and rated the realism of the drawings (1–10 scale). Only those drawings of balloon/lollipop and experimenter/child's mother that were indistinguishable from each other (realism of ≤ 5) were included in the final analysis. As the ASD group had a tendency to produce more highly realistic drawings than the typically developing group, 18/64 (28%) of the drawings were not included in the analysis. This comports with evidence that children with ASD are detail-oriented and focus on local elements (Happé and Frith 2006). The

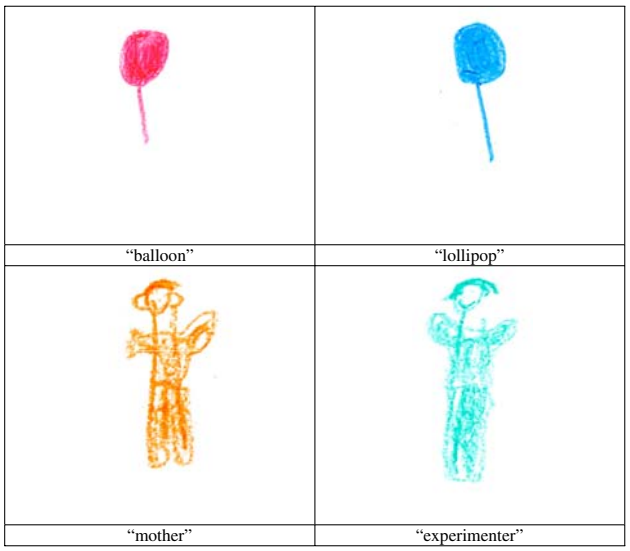

Fig. 1 Example of stimuli produced by children with ASD in Experiment 2

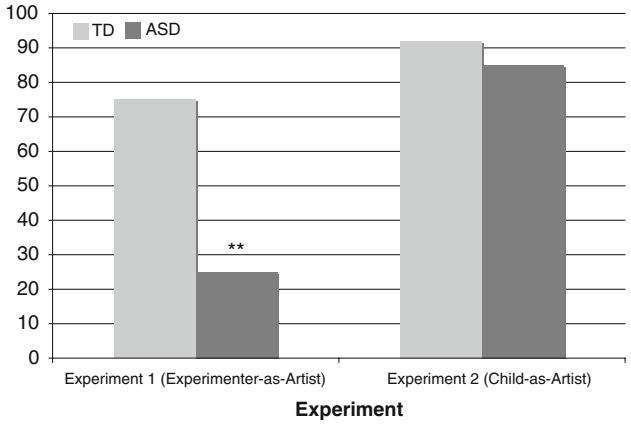

Fig. 2 Percentage of pictures correctly labelled according to the artist's intention for Experiment 1 (experimenter-as-artist) and Experimenter 2 (child-as-artist)

remaining pictures did not differ on realism between groups (ASD = mean 2.9, TD = 2.7; $t(28) = .93$, $p = .36$, $d = .35$), independent samples 2-tailed t-test).

Children with ASD (87%, 40/46) were equally likely as typically developing children (92%, 59/64) to name the drawings correctly—based on what they had *intended* the pictures to represent, a non-significant difference measured by an independent samples 2-tailed t-test, $t(27) = -.635$, $p = .75$, $d = .244$ (Fig. 2). There was no relation between the realism score of the drawings and naming accuracy ($r(30) = -.026$, $p = .895$).

General Discussion

Understanding pictures and how they work appears to rely heavily upon an individual's ability to decode the intentions of the artist. Young typically developing children naturally look for the intention behind the creation of a drawing when thinking about or naming visual depictions. This holds true when reasoning about their drawings, and importantly, when they interpret artwork created by others. Children with ASD, however, appear to decode their own pictures differently from those made by others.

In Experiment 1, children watched as an experimenter looked at one of two objects and pretended to draw it. Whereas typically developing children tended to use the experimenter's gaze as a cue for what the picture was supposed to represent, participants with ASD made many errors of a distinct type. Specifically, they tended to name the picture by its appearance only just as often as trying to relate the picture to one of the visible objects on the table. This kind of error represents a critical misinterpretation about how pictures work—children with ASD might not be spontaneously linking pictures to real world referents. This could reflect a fundamentally different process by which

children with ASD reason about visual representations created by others.

However, children with ASD did show the same pattern of results as typically developing children in Experiment 2 when they were asked to draw their own pictures. In this case, they were able to successfully label their pictures after a delay even though they were not perceptually different (except by color). By drawing the pictures themselves, children were able to recognize their pictures based upon what they intended them to be. This is consistent with Peterson (2002), in which children with ASD were able to remember their own mental state when they drew a simple picture in a false drawing task. However, the current results might reflect a ceiling effect, since both groups scored so highly.

One alternative possibility is that the children with ASD are solving the task from Experiment 2 without accessing anything 'intentional' about their artwork. They could be associatively pairing the color of the depiction with the name, and using color as a retrieval cue. This is concordant with evidence suggesting children with autism learn associatively (see Preissler 2008). Additionally, memory differences between the two groups may have contributed to different recall strategies—specifically, the ASD group may have simply forgotten their own intention, but may have recognized their drawing as a complex symbol in association with the object. Some of the spontaneous comments produced by the children with ASD challenge this interpretation. When asked to identify the picture of the experimenter, one child spontaneously exclaimed, "that's you! Can't you tell? It's the one with the big nose!" The picture looked indistinguishable to the one drawn of the child's mother, but it was clear that the child had remembered his own *intention* to draw the experimenter, and not simply an association.

Could results between ASD and non-ASD groups reflect chronological age (CA) differences? Unfortunately, pilot testing revealed that the paradigms were not appropriate for CA-matched typical peers. In Experiment 1, older children thought the experimenter was trying to trick them and did not know how to respond, due to the strange pragmatics of the situation. Experiment 2 proved more difficult, as all controls created extremely realistic pictures, preventing an interpretable result.

It is clear that however children with ASD are solving the problem, representational properties of their own drawings are salient. Focusing children with ASD upon these representational aspects may facilitate their understanding of symbolic aspects in other domains, including play and language (see Preissler 2006). Thus, interventions targeting symbolic relations should incorporate 'decoding' of drawings.

Children with ASD appear to be naïve realists when reasoning about other people's artwork—focusing upon the appearance of the picture. However, when they create drawings, they more easily relate the drawing to an external object, suggesting they are more likely to focus on the symbol-referent relation. Of course, typically developing individuals also consider what a picture looks like when determining what it is (Gombrich 1960; Ittelson 1996; Browne and Woolley 2001); but fully understanding artwork requires an intentional stance.

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