Impaired eye contact linked to autistic "theory of mind" defect

One of the first signs of autism noted by most parents is that their childen "look right through them," or even appear to avoid looking at them. Several studies show, however, that autistic children don't actually avoid making eye contact; rather, they fail to make eye contact at appropriate times.

British researcher Simon Baron-Cohen and his colleagues have been investigating the hypothesis that autistic individuals lack a "theory of mind"—that is, an understanding that other people have thoughts and feelings. The researchers speculate that "part of the explanation for the gaze abnormalities in autism may be a failure to comprehend that the eyes convey information about a person's mental states."

To test their theory, Baron-Cohen et al. set up several experiments. Subjects included 20 autistic children, 30 mentally handicapped children, and 20 non-disabled four-year-olds. The disabled subjects were matched for both chronological age and verbal mental age.

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Initially, the researchers simply tested whether or not autistic children could judge the direction of a person's gaze. The researchers found that their autistic subjects had no difficulty with this task. The researchers then conducted three experiments to test whether or not autistic children could infer mental information from a person's gaze.

The "four sweets" task

The first experiment was a "four sweets" task, in which children viewed a picture with a cartoon face in the center and a different candy bar at each corner. The eyes of the cartoon figure were looking at one of the candy bars.

The children were asked to identify each sweet, and tell which one they themselves would like. Then they were shown the cartoon. (In each case, the child was shown a cartoon face that was looking at a candy bar different than the one he or she had selected.) To test the children's awareness of other people's desires, the researcher told the children, "This is my friend Charlie. Charlie wants one of these sweets. Which one does Charlie want?" In a similar test, this time to see if the children recognized other people's goals, the researcher said, "Here is Charlie again. He is going to take a sweet. Which one is he going to take?"

A third variant of this experiment tested whether autistic children could recognize another person's intent to refer them to an object. In this test, the children were shown two shapes, and told, "one of these is a beb [or other nonsense word]. Which one is the beb?" Then the experimenter showed a cartoon face looking at one of the shapes. The experimenter said, "Charlie says, 'There's the beb!' Which one does Charlie say is the beb?"

The researchers found that in all variations of this experiment, "the group with autism [performed] significantly lower than chance," and that their errors were not random but were largely in the "egocentric" category. In other words, autistic subjects selected the candy bar they were interested in, or the shape they had selected, not the one at which the cartoon face was looking.

The "natural pointer" task

In the next experiment, Baron-Cohen et al. tested whether autistic children use the eyes as natural cues. The experiment was the same as the previous one, except that each cartoon-face drawing also included an arrow pointing from the face to the correct candy bar. In addition, the children were shown drawings in which the arrow pointed to a different candy bar than the one at which the cartoon face was gazing.

The researchers found that "when normal subjects or those with mental handicap approach this task, they show a spontaneous preference for the natural cue (eye-direction) over an unnatural cue (arrow direction). In contrast, the subjects with autism tend to use the unnatural cue of the arrow direction to guide their judgment, acting as if this is more important than eye direction."

The "thinking" test

In a final experiment, the researchers tested whether autistic children could tell that another person was thinking. Subjects were shown photos of individuals either looking directly toward the camera, or looking to one side and upward as if in thought. Subjects were asked, "which one is thinking?" Again, individuals with autism were impaired on the task compared to both non-disabled and mentally handicapped subjects.

Baron-Cohen et al. say their findings indicate that "children with autism have difficulty in understanding the *concepts* of desire, goal, intention to refer and think, resulting in them not mapping these onto behavior such as eye-direction." In short, they say, autistic children may be "blind" to the mental information other people convey with their gaze.

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"Are children with autism blind to the mentalistic significance of the eyes?," Simon Baron-Cohen, Ruth Campbell, Annette Karmiloff-Smith, Julia Grant, and Jane Walker; *British Journal of Developmental Psychology*, Vol. 13, 1995, pp. 379-398. Address: Simon Baron-Cohen, Departments of Experimental Psychology and Psychiatry, University of Cambridge, Downing Street, Cambridge CB2 3EB, UK.

Serotonin: too much or too little?

Many researchers have found high levels of serotonin in the blood of autistic subjects. However, it's not yet clear if high blood serotonin levels mean that serotonin levels in the brain are elevated as well. A new study by Italian researchers suggests that just the opposite may be the case: autistic individuals may have brain serotonin levels that are too *low*, not too high.

P. D'Eufemia and colleagues examined serum levels of tryptophan (the major "building block" of serotonin) and of large neutral amino acids (LNAAs), substances that "hitch a ride" across the blood-brain barrier using the same carrier as tryptophan. These other amino acids, in effect, compete with tryptophan for entry into the brain. Thus, a low ratio of tryptophan in comparison to these substances suggests reduced serotonin synthesis in the brain.

The researchers report that "a significantly lower serum tryptophan/LNAA ratio was observed in the autistic subjects compared to the normal controls," and that in 14 of their 40 autistic subjects, "this ratio was two standard deviations below the mean value obtained in the control group." D'Eufemia et al. say their findings "suggest that a low brain tryptophan availability due to a low serum tryptophan/LNAA ratio could be one of the possible mechanisms involved in the alteration of serotonergic function in autism."

The suggestion that low, not high, serotonin may cause autistic symptoms does not surprise some researchers. Low serotonin levels have been strongly linked to behavioral problems including aggression, impulsivity, violent suicide, arson, and depression.

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"Low serum tryptophan to large neutral amino acids ratio in idiopathic infantile autism," P. D'Eufemia, R. Finocchiaro, M. Celli, L. Viozzi, D. Monteleone, and O. Giardini; *Biomed. & Pharmacother.*, Vol. 49, 1995, pp. 288-292. Address: P. D'Eufemia, Department of Pediatrics, University La Sapienza, viale Regina Elena 324, 00161 Rome, Italy.

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