ABSTRACT
In an earlier study using a head-worn stereoscopic display and eye tracker, high-functioning Autism Spectrum Disorder (ASD) participants looked less than controls at the interior of the face (Trepagnier, et al., 2002). We report here preliminary results for a similar task using a desk-top tracker and monitor display. Of the 9 experimental group participants whose data have been analyzed to date (mean age 17.5, range 12.1 to 22.8, all with a clinical diagnosis of Aspergers Disorder, 2 female), correlations for gaze duration and for number of initial fixations on eyes with the ADI-R social subscore were -.747 and -.832, respectively. Seven of the 9 met Autism Diagnostic Interview (ADI-R) social subscore criterion for ASD. For these 7, correlations were -.729 and -.832 (all correlations significant at p < .05). A trend in the same direction for total ADI-R score failed to reach significance.

In contrast, the overall pattern of gaze was similar for the two groups. Experimental group participants differed from controls only in that they produced significantly longer fixations at the background and more initial fixations on the mouth.

BACKGROUND
Reduced face-gaze relative to controls has been documented in visual records of infants later diagnosed autistic (Kubicke, 1979; Sparling, 1991; Osterling & Dawson, 1994), and empirical studies have suggested atypical distribution of face gaze in older children (Langdell, 1978; Hobson, et al., 1988). Recently video eye tracking has been used to measure localization of autistic face gaze, with findings of reduced attention to the eyes (Klin, et al., 2002) and to central face (Trepagnier, et al., 2002). Klin and colleagues also report that preferential attention to the mouth predicts better social functioning. Other investigators have found little or no difference between autistic and non-autistic participants (van der Geest, et al., 2002). We present preliminary results from a continuation of the study reported in Trepagnier et al. (2002) using two-dimensional (as opposed to stereoscopic) display.

Hypothesis:
We hypothesized that individuals with ASD would differ from controls matched for chronological and verbal mental age in that they would show less well-organized face gaze, in particular less gaze at the eyes and at the central face, and more gaze at the mouth and the (featureless) background.

We also wished to examine the relationship between face gaze distribution and development of the social impairments.

METHODS
Apparatus & Stimuli:
(A) - 24" CRT TV, 30" away from participant
(B) - ISCAN desktop eye tracker, 60Hz sampling frequency; 1 deg accuracy, dark pupil method
(C) - Intergraph workstation (stimulus presentation and data recording) & (D) - Pentium I PCC (control of eye tracker)
(E) - high-backed chair (head stabilized by air-evacuated polystyrene-lead cushion)

Procedure & Measures:
- Recognition task: 4 blocks of 24 trials
- 6 acquisition trials followed by 16 recognition trials: 8 repeats, and 8 foils (see examples on the right)
- eyetracker stimulus presentation: 4s (expressed as % total number of recorded initial fixations)

Calibration:
- 5-point calibration
- checked using two concentric circles around targets, diameter 0.5" & 0.5"
- Calibration repeated if seemed possible to improve or if measure beyond outer circle

Additional measures:
- Picture Peabody Vocabulary Test (PPVT)
- Autism Diagnostic Interview (ADI-R)

Participants:
Experimental group
n=9, mean age=17.4 years (12.1 - 22.8), 7 male, 2 female; clinical diagnosis of Aspergers Disorder
Control group
n=9, mean age=18.4 years (12.8 - 23.4), 5 male, 4 female

RESULTS & DISCUSSION
Gaze data analysis:
1. raw sensory data are transformed into screen coordinates by applying appropriate linear transformations; off-screen coordinates are treated as missing data
2. PORs are combined into fixations of min duration 100 ms, with maximum distance of 0.5 degrees visual angle from the fixation center
3. Fixations whose centers fall within predefined regions of interest (ROIs) are identified

Group comparisons:
1. % total fixation time within ROIs (during entire trial, 4s):
- Stimulus: pictures of faces and objects
- faces subtend same visual angle as actual faces at that distance
- half-inverted in blocks 3 & 4

Correlation with ADI-R social subscore:
A) % total fixation time within ‘Eyes’ ROI
B) initial fixations within ‘Eyes’ ROI

Discussion:
Over the 4 seconds of exposure, Experimental group participants’ larger amount of time spent on the background is consistent with reduced organization. Directing initial gaze at the mouth is consistent with earlier findings of attention to this area. There is the possibility, however, that the location of the fixation square, situated at the bottom of the screen, artificially added to this result. More surprising is the finding that although the Experimental group’s reduced gaze at the eyes did not reach significance, the inverse correlation within the group between gaze at eyes and ADI-R social score is large and significant. The ADI-R addresses early behavior, with special emphasis on the fifth year of life. Individuals’ behavior during childhood, then, appears to be related to the extent to which they attempt to recognize faces by looking at the eyes. While these data are provided by adolescents and young adults, it appears to be the case that face-gaze begins to be established in infancy (LeGrand et al., 2001). It is speculated that the gaze behavior displayed in this study is a glimpse back in time to the underpinnings of the social impairments that were evident by the developmental period addressed in the ADI-R.

At the same time, the pattern of gaze distribution of the Experimental group is not grossly different, consistent with the fact that the functioning level of these individuals is overall very high. It is not, then, surprising that some studies have failed to find difference, particularly if gaze data are acquired during a task that does not motivate the individual to attempt to remember, recognize or otherwise attend to the face.

CONCLUSION:
In an earlier paper (Trepagnier, 1996) it was proposed that failure to establish face-gaze in early life, because of an anxiety and/or mood disorder liability that might reduce the infant’s ability to cope with intense social stimulation, could of itself account for much of the social and communicative impairment of autism. The preliminary data reported here are modestly consistent with that hypothesis. The hypothesis will be tested directly if an intervention, now in development, to stimulate development of face attention and face interpretation proves workable.

REFERENCES:


