Exploring Consistency of Social Viewing in ASD

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Background

- Both electroencephalography (EEG) and eye-tracking (ET) are promising biomarker acquisition tools in ASD. Recent research has highlighted that, within an individual over time, the shape of the EEG power spectral density (PSD) exhibits high levels of test-retest reliability (1).
- Such test-retest reliability, however, has not been examined in ET.
- Research comparing monozygotic (MZ) and dizygotic twin pairs indicates that MZ twins exhibit striking levels of similarity in eye-tracking scan paths. Suggesting high-levels of biological control over attention (2,3).
- Here we sought to address three questions:
- (1) How similar are patterns of attention within the same individual over time?
- (2) Is individual consistency of looking different between typically developing (TD) children and those with ASD?
- (3) Is within individual consistency of looking related to the clinical phenotype?

Method

	ASD (n=280)	TD (n=119)	Statistical Test
Age (in years)	M=8.54 (1.64)	M=8.50 (1.61)	F(1,397) = 0.04, p = .86
Sex (male)	76.8% male	69.7% male	$\chi^2(1) = 2.19$, p = .14
DAS-II GCA (Full Scale IQ)	96.58 (18.1)	115.12 (12.6)	F(1,397) = 103, p < .001
Verbal Cluster Standard Score	95.95 (20.6)	116.27 (11.2)	F(1,397) = 102, p < .001
Special Nonverbal Composite	97.52 (16.9)	112.18 (14.1)	F(1,397) = 69, p < .001

- Data were collected from 280 individuals with ASD and 119 TD controls between the ages of 6 and 11 across five sites as part of the Autism Biomarkers Consortium for Clinical Trials (ABC-CT).
- ET was collected in two sessions at each of the following: an initial visit (T1), a six week follow up (T2). Data here reflect within person comparisons from T1 to T2.
- Similarity between ET scan paths was calculated as:
  - The correlation of binned gaze coordinates for identical stimuli, which reflects overlap in scan paths.
  - The difference of Shannon entropy between sessions, which reflects exploratory gaze behavior.
- Correlations were calculated with clinical measures: the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS), Vineland Adaptive Behavior Scales, 3rd Edition.

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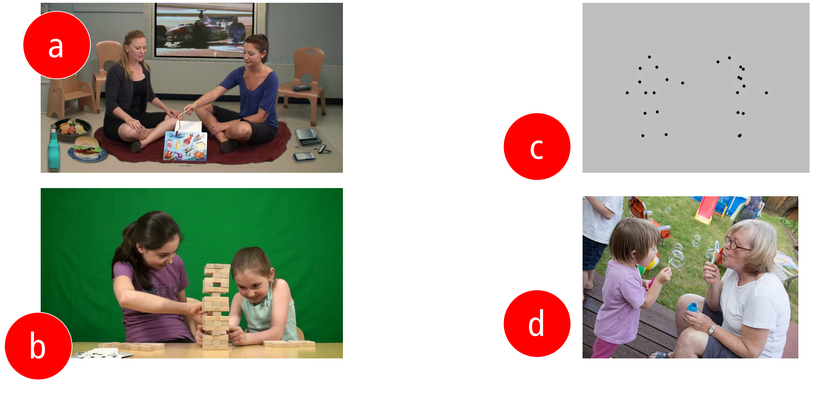
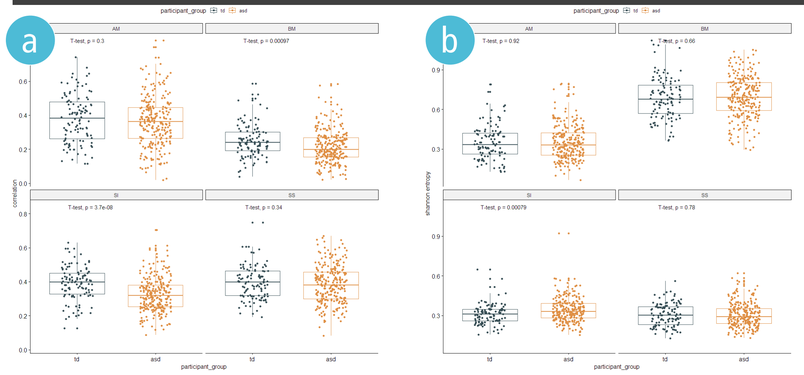
https://medicine.yale.edu/ycci/programsprojects/autism/postersandpapers/insar2020/

Method



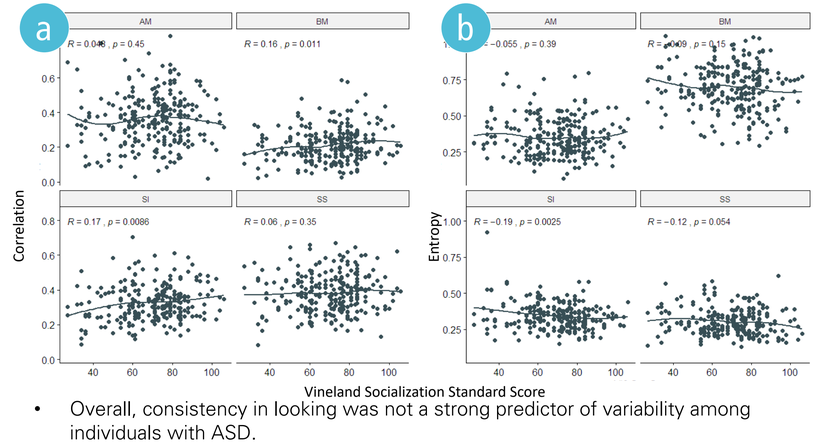
Social attention was measured in three dynamic experiments [activity monitoring (AM) (a), Social interactions (SI) (b), and biological motion (BM) (c)] and one static experimental [social scenes (SS) (d)].

Results: Scanpath Similarity



- Experiment, rather than individual, was the best predictor of consistency between T1 and T2. Panel A depicts within individual correlations and panel B depicts exploratory looking consistency.
- Individuals with ASD exhibited reduced consistency of scanpaths in BM and SI experiments relative to TD controls. These experiments exhibited the greatest amount of motion. There were not significant differences in SS or AM.
- With regards to exploratory behavior, groups only differed in SI. Individuals with ASD exhibited greater consistency in exploration.

Results: Clinical Correlations



- Overall, consistency in looking was not a strong predictor of variability among individuals with ASD.
- There was no relationship with either scan path or exploration consistency of looking and ADOS severity (all *p*s > .07).
- There were small correlations with the Vineland (a) such that increased consistency of looking (panel a) and reduced consistency of exploration (panel b) in SI and BM were associated with better social adaptive function. Each panel includes a local regression fit line to assess for the presence of non-linear relationships.

Conclusions

- We demonstrate that within individual consistency of looking patterns over time are driven strongly by stimulus properties and are highly variable among individuals.
- In some contexts, individuals with ASD exhibit reduced consistency, but the magnitude of between diagnostic group effects varied among experiments.
- Interindividual variability was, unexpectedly, weakly related to clinical characteristics. It is unclear whether this effect is particular to our experiments and measures (entropy, fisher correlations).
- Nevertheless, current results demonstrate that within-individual consistency can differentiate diagnostic groups. Exploring the sources of within-individual variability offers a novel approach towards refining our use of ET a biomarker tool in ASD.

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3. Kennedy, Daniel P., et al. "Genetic Influence on Eye Movements to Complex Scenes at Short Timescales." Current Biology, vol. 27, no. 22, Nov. 2017, pp. 3554-3560.e3. www.cell.com, doi:10.1016/j.cub.2017.10.007.