Examining data loss and the pupillary light reflex as a function of sensory sensitivities in children with and without ASD: Results from the Autism Biomarkers Consortium for Clinical Trials (ABC-CT)

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Background

- The pupillary light reflex (PLR) is a promising biomarker for autism spectrum disorders (ASD)
- PLR is linked to neural mechanisms of arousal and sensation
- PLR is experimentally elicited by a flash of light which may be aversive to autistic participants with sensory sensitivities and could lead to selective data loss
- Previous research has found longer PLR latency (time from flash to pupillary constriction) in ASD compared to non-autistic, typically developing (TD) participants
- The present study examined whether sensory sensitivities predict subsequent lost data in PLR experiments

Hypotheses

1. There will be greater sensory sensitivities, lost data overall, and lost data on PLR trials in autistic compared to non-autistic participants

2. Participants with more sensory sensitivities will have more lost data on PLR trials compared to non-PLR eye tracking (ET) measures (e.g., images of people) and will increasingly avoid (look away from) PLR trials over time

3. Participants with more sensory sensitivities and fewer valid PLR trials will have longer PLR latency

Methods

Participants

Data collected in the Autism Biomarkers Consortium for Clinical Trials (ABC-CT).

Group	n (n girls)	Mean Age (Y)	Age SD	FSIQ	FSIQ SD
ASD	280 (65)	8.55	1.65	96.58	18.11
TD	119 (36)	8.51	1.62	115.12	12.55

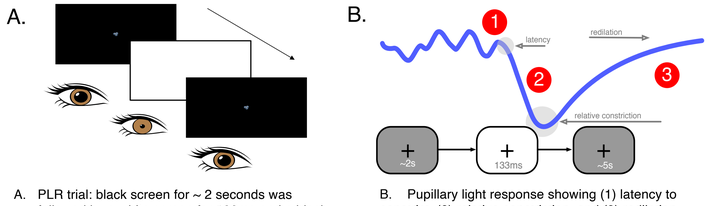
Behavioral Data

- Diagnosis was confirmed via the Autism Diagnostic Observation Schedule 2nd Edition (ADOS), the Autism Diagnostic Interview (ADI), and clinician confirmation of DSM-5 criteria

- Sensory sensitivities were measured with the Pervasive Developmental Disorders Behavior Inventory (PDDBI): Sensory Subscale

Pupil Data

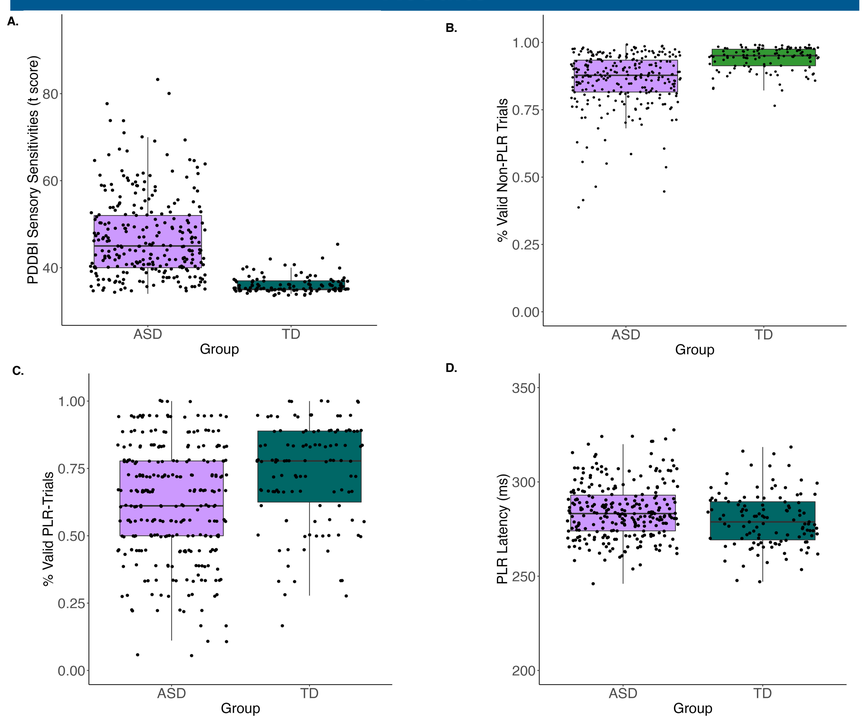
- Pupil dilation data were collected using an SR EyeLink 1000+ binocular remote camera system at 500 Hz
- PLR was calculated in response to a 133ms white flash followed by a black screen
- PLR latency was defined as the time from flash to pupillary constriction
- All participants completed two ET sessions including 18 PLR trials and about 20 minutes of non-PLR measures



A. PLR trial: black screen for ~ 2 seconds was followed by a white screen for 133ms and a black screen for ~5 seconds

B. Pupillary light response showing (1) latency to constrict, (2) relative constriction, and (3) redilation

Results

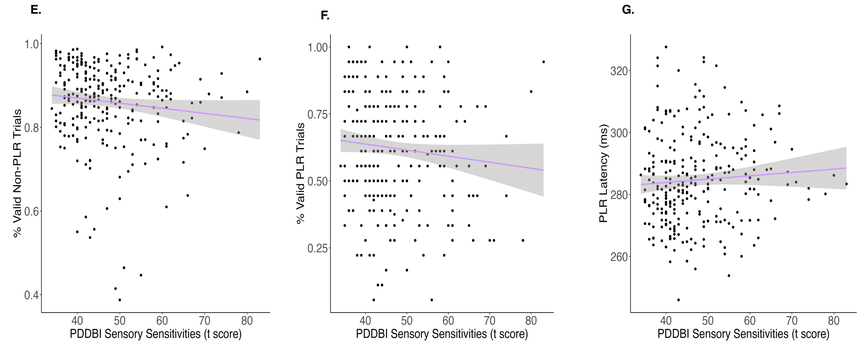


Group Differences in Dependent Measures (Hypothesis 1)

A. Autistic participants (M = 14.21; SD = 11.06) demonstrated **greater sensory sensitivities** on the PDDBI: Sensory Subscale than TD participants (M = 1.19; SD = 2.21; $\mathbf{p < .0001}$)
B. Autistic participants (M = 86% valid; SD = 10%) had **more lost data** (fewer valid trials) on non-PLR ET measures than TD participants (M = 94% valid; SD = 4%; $\mathbf{p < .0001}$)
C. Autistic participants had **fewer valid PLR trials** (M = 62% valid; SD = 21%) than TD participants (M = 72% valid; SD = 20%; $\mathbf{p < .0001}$)
D. Autistic participants (M = 284.39ms; SD = 18.93) had **longer PLR latency** on valid PLR trials than TD participants (M = 279.25ms; SD = 17.41; $\mathbf{p < .0001}$)

Differences in Data Loss for Autistic Participants (one-sample t test)

- Autistic participants lost significantly more data on PLR trials (M = 62% valid; SD = 21%) than non-PLR ET measures (M = 89%; SD = 8%; $\mathbf{p < .0001}$)



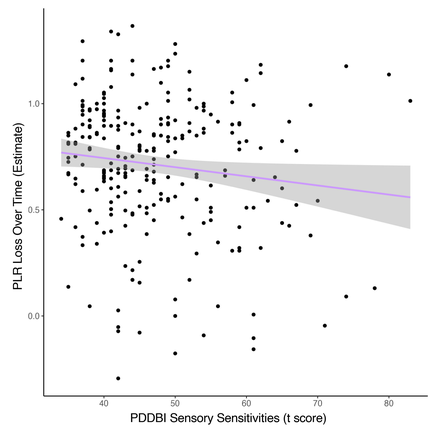
Pearson Correlations of Dependent Variables (Hypotheses 2 (E,F, H) and 3 (G))

Correlations computed only among autistic participants.

E. **Higher sensory sensitivities** correlated with **more lost data** ($r(267) = -.13$, $\mathbf{p = .033}$)
F. **Higher sensory sensitivities** correlated with **fewer valid PLR-trials** ($r(267) = -.10$, $\mathbf{p = .094}$)
G. Higher sensory sensitivities did not correlate with longer PLR latencies ($r(267) = .07$, $p = .27$)

Results

Regression of Individual Effect of Sensory Sensitivities on PLR Data Loss Over Time



PLR loss over time was negatively correlated with sensory sensitivities such that **autistic participants with more sensory sensitivities lost more PLR data over time than those with fewer sensitivities** ($r(263) = -.13$, $\mathbf{p = .037}$)

There was no significant correlation with
Age: $p = .81$
IQ: $p = .22$
ADOS SS Comparison: $p = .14$
SRS t scores: $p = .16$

Conclusions

- Autistic children demonstrated longer PLR latencies, more lost data, and greater sensory sensitivities than TD children
- Autistic children lost more data on PLR trials than other eye tracking measures
- Autistic children with more sensory sensitivities had fewer valid PLR trials than those with fewer sensitivities
- Autistic children with more sensory sensitivities likely experience the flash as aversive, are predicting when it will come, and are looking less at the screen during the PLR paradigm, resulting in fewer valid trials over time
- These data suggest that current research comparing ASD and TD children may underrepresent differences in biomarkers like PLR because data loss is non-random and specific to one group

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