Autism symptom severity, adaptive behavior, and cognitive functioning associated with inattention, noncompliance, and track loss during eye-tracking: Results from the Autism Biomarkers Consortium for Clinical Trials (ABC-CT)

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Background

- Eye-tracking (ET) provides an objective measure of visual attention and is commonly deployed in research with autistic populations
- Inattention and noncompliance reduce data quality and increase attrition
  - Participants may be excluded due to high rates of data loss[1,2]
  - Excluded participants are often those least represented in autism research (e.g., lower cognitive ability)
  - Reduces generalizability of findings to wider autism community

Objectives:

1. Evaluate whether autistic participant take more breaks during ET than typically developing (TD) participants
2. Evaluate how social function impacts the number and type of breaks taken during ET within autistic participants

Methods

ABC-CT Study Details:

- Multi-site, longitudinal study designed to develop objective and reliable biomarkers of social functioning in ASD
- A large sample of children with and without ASD completed a battery of clinical assessments and electroencephalography (EEG) and ET assays

Participants:

	n	ADOS-2	Age (years)	FSIQ	% female
ASD	278	7.64 (1.82)	8.54 (1.64)	96.75 (18.05)	23.4
TD	117	1.58 (0.87)	8.51 (1.62)	115.36 (12.36)	30.7

Table 1. Participant demographic information

Clinical Measures:

- Vineland Adaptive Behavior Scales, Third Edition (VABS-3)
  - Adaptive Behavior Composite (ABC)
  - Communication, Daily Living Skills, and Socialization Subdomains
- Differential Ability Scales (DAS-II Full Scale IQ)
- Autism Diagnostic Observation Schedule, Second Edition (ADOS-2)

Eye-Tracking Acquisition

- Binocular eye-tracking data were collected at 500 Hz using a SR Eyelink 1000 Plus
- Passive-viewing paradigm with experimenter-mediated breaks

Statistical Analyses

- Zero-inflated Poisson regression due to excessive zeros
- Dependent variable: Number of breaks (including subgroups)
- Independent variable: Diagnostic status and clinical measures
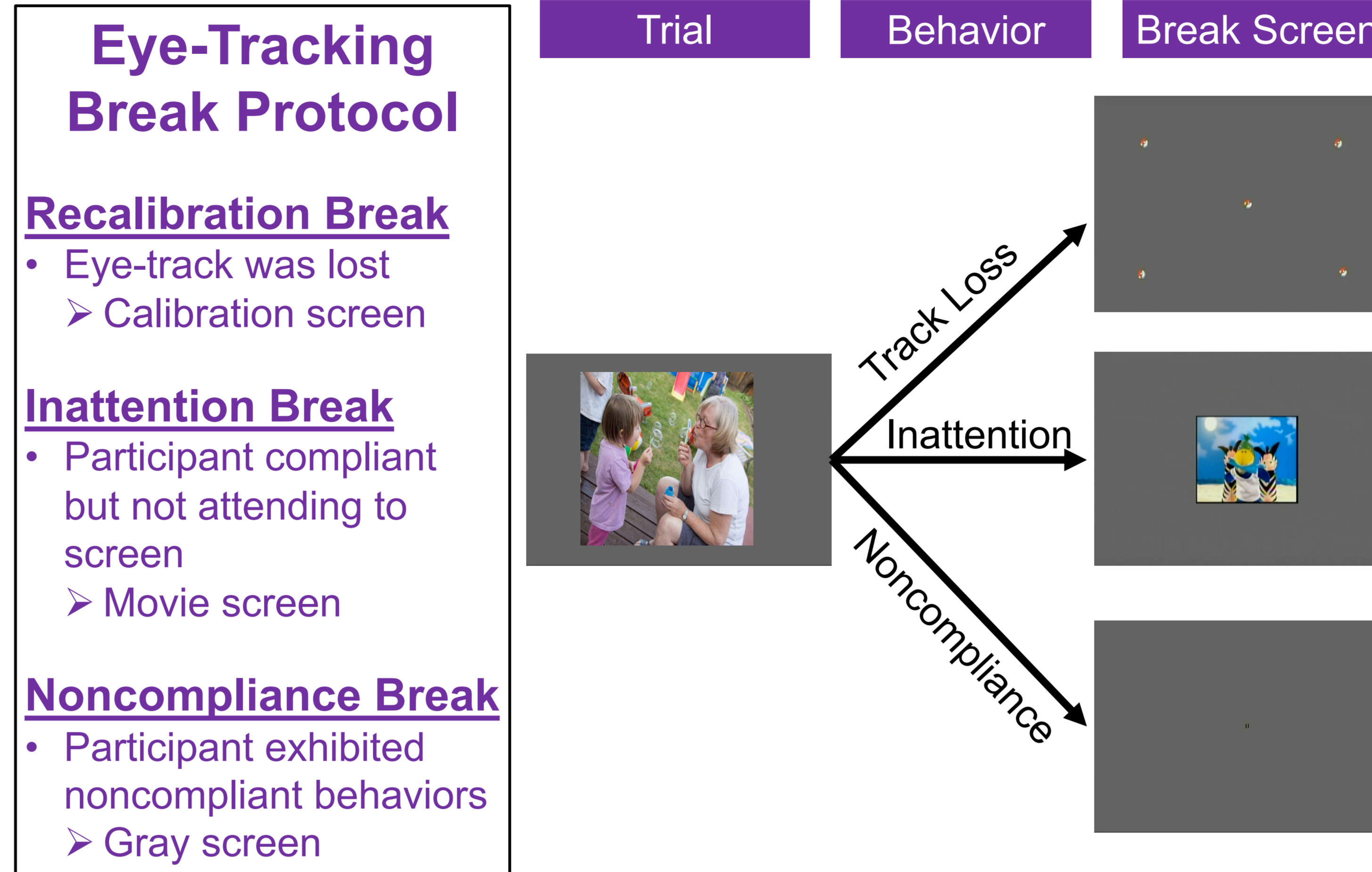
Methods Cont.

Eye-Tracking Break Protocol

Recalibration Break
- Eye-track was lost
  ➢ Calibration screen

Inattention Break
- Participant compliant but not attending to screen
  ➢ Movie screen

Noncompliance Break
- Participant exhibited noncompliant behaviors
  ➢ Gray screen

Figure 1. Eye-tracking Break Protocol

Results

ASD participants received more breaks than TD participants

- **Being in the ASD group increases the odds of taking at least one break by 55%** (p = .05).
- **Among participants with at least 1 break, ASD group takes 2.07 times more breaks than TD group** (p <.001).
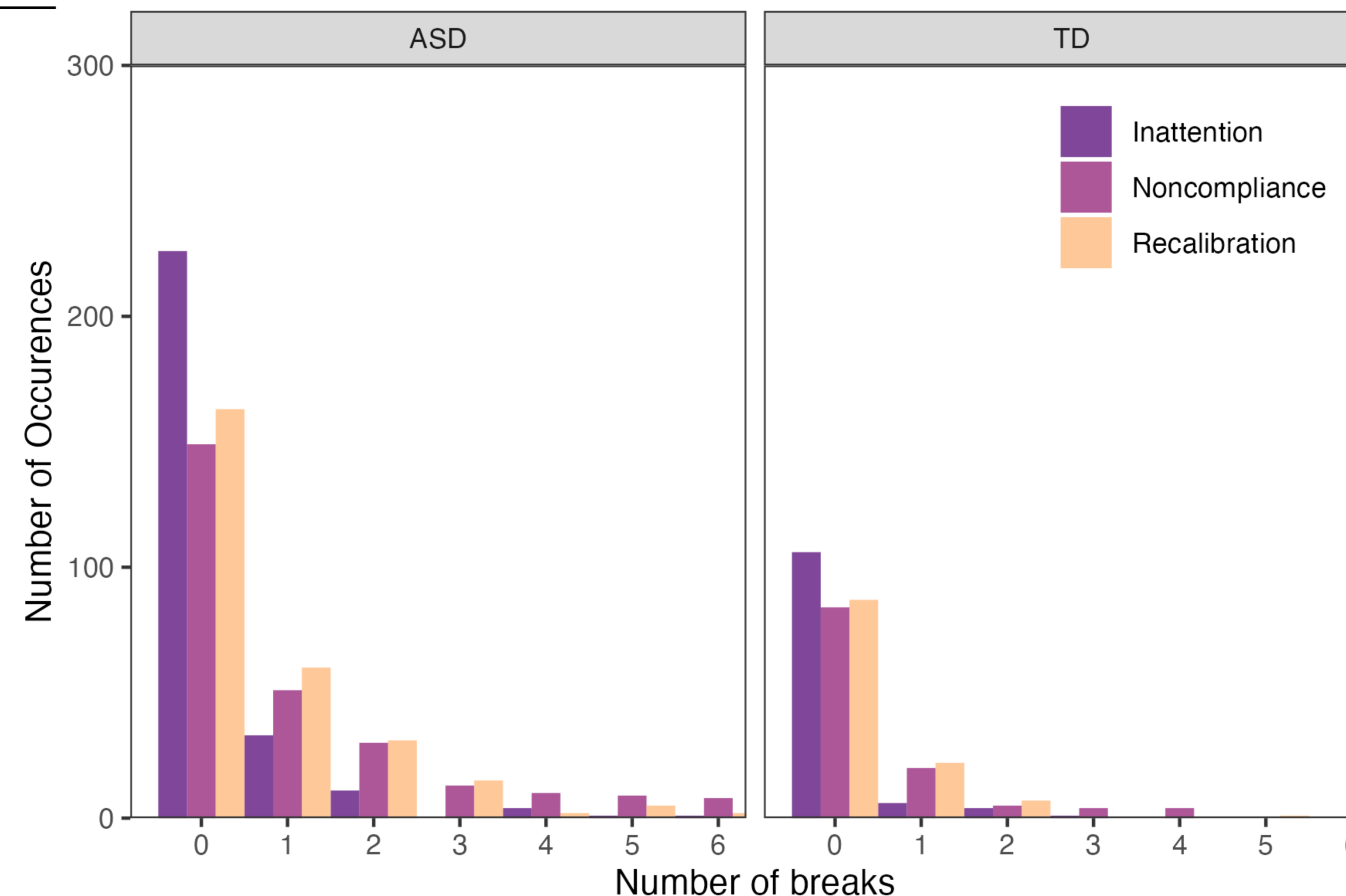

Figure 2. Individual count data for ASD and TD participants

Results Cont.

Adaptive functioning and IQ predict number of breaks taken in autistic participants

	Recalibration	Inattention	Noncompliance
ABC	b=0.97, p<.001	b=1.00, p=0.87	b=0.99, p=0.33
Communication	b=0.98, p<.001	b=0.99, p=0.42	b=1.00, p=0.89
Daily Living	b=0.98, p<.01	b=1.00, p=0.37	b=0.99, p=0.35
Socialization	b=0.98, p<.01	b=1.00, p=0.68	b=0.99, p<.05
IQ	b=0.99, p=0.38	b=0.98, p<.05	b=0.99, p<.05
ADOS	b=1.14, p<.05	b=1.09, p=0.29	b=0.99, p=0.89

Table 2. Break Types x Clinical Features Matrix
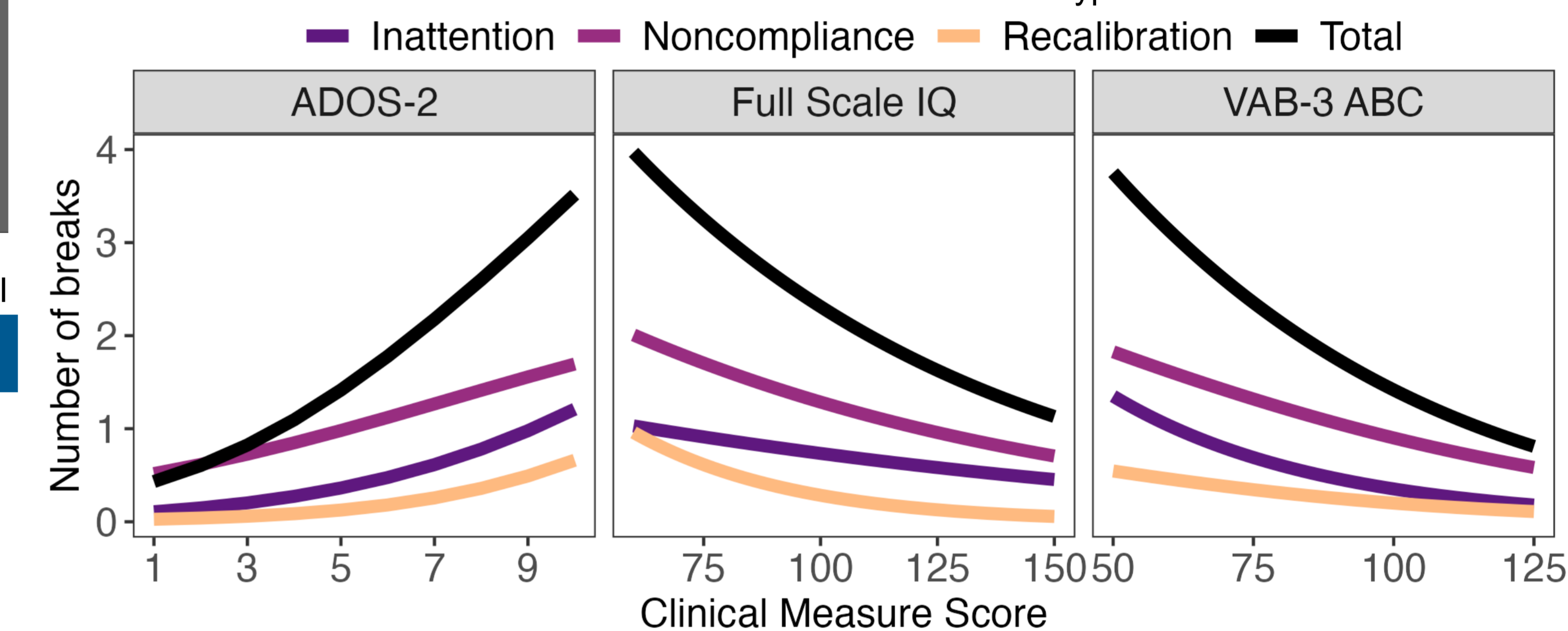

Figure 3. Model implied predictions for number of breaks as function of clinical measure scores

Conclusions

Autism symptom severity, adaptive behavior, and cognitive functioning predicted the degree of inattention, noncompliance, and track loss during eye-tracking.

Experimenter-mediated break protocols may be useful to prevent data loss, especially when ET tasks are sensitive to inattention or noncompliance

Future research should evaluate the empirical impact of experimenter-mediated break protocols on ET data quality in autistic participants.

References

1. Gaigg, S. B., Krug, M. K., Solomon, M., Roestorf, A., Derwent, C., Anns, S., Bowler, D. M., Rivera, S., Nordahl, C. W., & Jones, E. J. H. (2020). Eye- Tracking Reveals Absent Repetition Learning Across the Autism Spectrum: Evidence From a Passive Viewing Task. *Autism Research*, *13*(11), 1929-1946. https://doi.org/https://doi.org/10.1002/aur.2368
2. Chawarska, K., Macari, S., & Shic, F. (2012). Context modulates attention to social scenes in toddlers with autism. *Journal of child psychology and psychiatry, and allied disciplines*, *53*(8), 903–913. https://doi.org/10.1111/j.1469-7610.2012.02538.x

Funding Sources

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