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Teacher- and Parent-Reported Trajectories of Maladaptive Behaviors Among Individuals with Autism and Non-Spectrum Delays

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Abstract

People with autism spectrum disorder (ASD) and non-spectrum developmental delays frequently exhibit maladaptive behaviors throughout the lifespan, which can have pervasive effects on quality of life. Maladaptive behaviors have been shown to change over time as a function of various individual-level factors (e.g., cognitive ability), yet research is primarily limited to parent-reported measures. To expand upon this work, the present study aimed to examine trajectories of teacher- and parent-reported maladaptive behaviors (i.e., hyperactivity, irritability, social withdrawal) and to test whether individual-level predictors (e.g., autism features, verbal intelligence quotient) and school-related predictors (e.g., teacher type, student-adult ratio, personal aide, school type) impact these trajectories among 165 individuals with ASD or non-spectrum delays from ages 9 to 18. Multilevel models revealed that, according to both teacher and parent report, participants showed the greatest improvement in hyperactivity, less but still notable improvement in irritability, and stable levels of social withdrawal over time. Higher verbal ability and fewer ASD features, in addition to mainstream school placement, emerged as important individual- and school-related differences associated with fewer maladaptive behaviors over time. The multi-informant perspective and longitudinal design provide novel insight into the manifestations of these maladaptive behaviors across different contexts and across time. Findings highlight the consistency of teacher- and parent-reported trajectories over time and further emphasize the importance of targeting maladaptive behaviors using a multi-system intervention approach in both school and home contexts.

Lay Summary

According to both teacher and parent report, youth with autism and non-spectrum developmental delays showed the greatest improvement in hyperactivity, less but still notable improvement in irritability, and stable levels of social withdrawal from late childhood to early adulthood. Fewer autism features, greater verbal ability, and mainstream school placement were related to fewer maladaptive behaviors over time. This study's use of multiple reporters (e.g., teachers and parents) over the years showcased that the changes in teacher-reported maladaptive behaviors from childhood through adolescence are highly similar to parent report, which highlights the need to consider and address these behaviors across both school and home contexts.

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Keywords

Maladaptive behaviors; autism; longitudinal; multi-informant; teacher report; trajectories

Individuals with autism spectrum disorder (ASD) and non-spectrum developmental delays can have maladaptive or challenging behaviors throughout the lifespan (Lecavalier et al., 2006; Shattuck et al., 2007; Simonoff et al., 2008). Maladaptive behaviors interfere with everyday functioning and include behaviors such as hyperactivity, irritability, social withdrawal, self-injury, and aggression (Shattuck et al., 2007). These behaviors are more common among children with ASD than among children with other conditions (e.g., intellectual disability, language impairment, Down Syndrome, Fragile X, Williams Syndrome, cerebral palsy, etc.) and children without delays (Blacher & McIntyre, 2006; Gadow et al., 2005; Gillott et al., 2001; Tonge & Einfeld, 2003). Studies identify a prevalence rate of at least 50% in ASD, with higher rates noted in clinically-referred compared to population-derived samples (Baghdadli et al., 2003; Holden & Gitlesen, 2006; Kozlowski & Matson, 2012; Matson et al., 2008; Simonoff et al., 2008). Maladaptive behaviors have been shown to affect academic achievement, social competence, and adult psychiatric functioning both among individuals with and without ASD (De Bildt et al., 2005; Kim et al., 2000) and strongly impact caregiver and teacher stress (Lecavalier et al., 2006). However, despite the high prevalence and functional impairment associated with maladaptive behaviors in ASD, our understanding of how these behaviors change across time and across contexts consists primarily of parent-report measures completed cross-sectionally. In the present study, we take advantage of longitudinal data from teacher report, in addition to parent report, to begin to address these questions.

Maladaptive behaviors in ASD may wax and wane across development due to a host of external (e.g., social contexts) and internal (e.g., biological and developmental) factors. For example, the increased independence, more nuanced social interactions, and higher social expectations and demands that accompany adolescence, coupled with the onset of puberty, may exacerbate maladaptive behaviors including social withdrawal, irritability, aggression, and destructiveness (Anderson et al., 2011; Kobayashi et al., 1992). At the same time, self-regulatory abilities become increasingly internalizing (Sameroff, 2010) as the frontal lobe and associated executive function abilities develop (Blakemore & Choudhury, 2006), which sets the stage for improved self-control over maladaptive behaviors as a child matures. Therefore, longitudinal research on maladaptive behaviors is critical to shed light on how these behaviors unfold from childhood through adolescence in ASD across various social contexts (i.e., school and home).

Although there are few longitudinal studies tracking maladaptive behavior trajectories in ASD over time, existing literature based on parent report suggests a trend of improvement in maladaptive behaviors with age, particularly externalizing behaviors (Shattuck et al., 2007; Stringer et al., 2020; Woodman et al., 2015). This work includes a parent-reported study of participants who were drawn from the same longitudinal study as the current sample (Anderson et al., 2011; see Table S1 for a summary of study differences). However, improvement is not universal; for example, cognitive ability is consistently identified as a

education classrooms, and specialized schools, along with the potential for placements to change from grade to grade (Gindi, 2020). In addition to varying classroom and school placements, other school-related factors also differ across students with ASD including the level of support within a classroom (e.g., number of adults in the classroom or having a personal aide). Although these differences in school environments may be intertwined with the student's level of independent functioning (e.g., children with lower IQ may require the added support of a contained special education classroom placement; White et al., 2007), it may also be that certain classroom environments impact maladaptive behaviors and teacher reporting. For example, the degree to which teachers have expertise in ASD and the level of contact between students and teachers may affect maladaptive behavior trajectories, above and beyond individual differences between students.

Although we have some understanding of the maladaptive behavior trajectories and individual-level factors that influence them from the parent perspective, no study to the authors' knowledge has tracked teacher-reported maladaptive behaviors over time. In light of this need, the present study aimed to 1) examine trajectories of teacher- and parent-reported maladaptive behaviors (i.e., hyperactivity, irritability, social withdrawal) among individuals with ASD or non-spectrum delays from ages 9 to 18, 2) test whether individual-level predictors (e.g., autism features, verbal intelligence quotient (VIQ), etc.) impact these trajectories, and 3) assess school-related predictors (e.g., teacher type, student-adult ratio, personal aide, school type) of teacher-reported trajectories of maladaptive behaviors.

Methods

Participants

Participants were recruited from three sources: (1) 192 children under age 3 years referred for possible ASD to two tertiary autism programs (North Carolina and Illinois); (2) 21 children under age 3 years with non-ASD developmental delays identified through the referral sources of the first group (North Carolina and Illinois); and (3) 40 children with ASD or neurodevelopmental delays also diagnosed at early ages who joined the study at approximately age 9 and then were followed at the same ages as the first two groups (Michigan) (Anderson et al., 2014). By age 9 (mean (M) years = 9.98, standard deviation (SD) = 0.89), the full sample had joined the study and most had completed one or more in-person assessments. Additional in-person assessments occurred at approximately ages 19 (M = 19.04, SD = 1.2) and 26 (M = 25.97, SD = 1.4). Biannual packets of questionnaires were completed throughout the entirety of the study.

Of the original 253 participants, 165 were selected for this study based on availability of teacher- and parent-reported data between ages 9 to 18. A majority had more than one time point of teacher-reported data (77.6% completed two or more, 70.9% completed three or more, 63.6% completed four or more, 57% completed five or more) and parent-reported data (86.1% completed two or more, 83% completed three or more, 80% completed four or more, 77.6% completed five or more), with over five teacher-reported time points and over ten parent-reported time points on average per participant. Comparing our sample of 165 participants to the original sample of 253 participants, attrition was higher among participants with lower levels of autism features based on Autism Diagnostic Observation

Schedule (ADOS; Lord et al., 2000, 2012) calibrated severity scores (ADOS-CSS; $p = .035$; Gotham et al., 2009) and more advanced caregiver education ($p = .006$), but not associated with gender, recruitment site, diagnosis, race, or VIQ. Among the 165 participants in the current sample, 24.8% identified as Black and the remainder identified as White (see Table 1). The sample was predominantly male (79.4%) with 52.1% from North Carolina, 30.9% from Illinois, and 17% from Michigan. Approximately half of the sample reported a caregiver education level of at least a 4-year college degree (47.9%). Additionally, despite early developmental delays, 21.2% of the sample never received a formal diagnosis of ASD throughout the course of the longitudinal study. These participants are included in this study because they show similar patterns in presentation and outcome across development to the participants with ASD (Lord et al., 2020; McCauley et al., 2020); to account for these diagnostic differences, the ASD history of participants (ever/never ASD) and the level of autism features (using ADOS-CSS) were tested as covariates.

Procedures

This research was approved by institutional review boards at various institutions. Informed consent was obtained from all caregivers and individuals themselves whenever possible. Various diagnostic instruments, parent interviews, cognitive testing, questionnaires, and standard demographic forms were administered in-person (see Anderson et al., 2014). Participants, their parents, and their teachers also completed questionnaires via mail multiple times throughout the study (16 times spaced on average 6 months apart between ages 9–18). Teacher packets, which included teacher consents, questionnaires, and pre-addressed return envelopes, were mailed to parents with the instruction to distribute to the identified teacher/s. Teachers were mailed a small gift as compensation. If the teacher forms were not returned, parents consented for teachers to be contacted directly by the study team. Clinicians conducting the in-person assessments, generally a post-doctoral fellow or licensed clinician and a research assistant, were research reliable in the relevant measures and were blind to the participants' previous assessment results. Diagnoses of ASD or other disorders were made by the research team and presented to a panel of experienced clinicians to come to a consensus on diagnoses of ASD and other conditions. All assessments were provided free of charge and included feedback on testing results.

Measures

Autism Features.—Participant ADOS-Calibrated Severity Score (ADOS-CSS) at age 9 (if unavailable, then from later years: ages 19 or 26) was used to describe level of autism features. At each in-person assessment, participants were administered the ADOS (Lord et al., 2000, 2012). The ADOS-CSS (Gotham et al., 2009) can be used to compare ASD features across individuals of different developmental levels. ADOS-CSS scores range from 1 to 10, with higher scores indicating higher levels of autism spectrum-related features observed during the ADOS.

Verbal Intelligence Quotient (VIQ).—Cognitive assessments were administered at each face-to-face assessment. The instrument used to obtain VIQ scores at age 9 (if unavailable, then from later years) was selected from a standard hierarchy including the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999), Wechsler Intelligence Scale for

Children (WISC-III; Wechsler, 1991), and Differential Abilities Scale (DAS; Elliott, 1990, 2007), depending on the child's language level and previous cognitive testing battery. Ratio VIQs were calculated from age equivalents when raw scores were outside deviation score ranges. VIQ was used for sake of consistency with existing literature (Anderson et al., 2011; Shattuck et al., 2007; Woodman et al., 2015).

Maladaptive Behaviors.—The Aberrant Behavior Checklist (ABC; Aman et al., 1985) is a 58-item checklist designed to assess maladaptive behaviors in individuals with developmental disabilities across five subscales: Hyperactivity, Irritability, Social Withdrawal/Lethargy, Stereotypic Behavior, and Inappropriate Speech. Items are scored on a four-point Likert scale ranging from (0) “not at all a problem” to (3) “the problem is severe in degree”. For this study, the Stereotypic Behavior and Inappropriate Speech subscales were excluded from analyses due to the significant overlap of these items with core ASD features (Anderson et al., 2011; Fok & Bal, 2019). Furthermore, hyperactivity, irritability, and social withdrawal/lethargy emerge as particularly important outcomes in ASD given their high prevalence (Simonoff et al., 2008) and significant impact on quality of life (Anderson et al., 2011; Gerber et al., 2008). Teachers and parents completed the ABC twice yearly to capture participants' maladaptive behaviors from approximately ages 9 to 18. Teachers also reported whether they were a special or general education teacher, whether their school was specialized (i.e., center-based, diagnosis-specific, etc.) or mainstream (i.e., inclusive education), the number of students and staff in their classroom to calculate student-adult ratios in the classroom, and whether the participant in the study had a personal aide in the classroom. The ABC has been found to have robust psychometric properties across teacher- and parent-report versions including moderate-to-high reliability (Aman et al., 1985, 1987; Freund & Reiss, 1991), good validity (Aman et al., 1985; Rojahn & Helsel, 1991), and strong psychometric performance among individuals with ASD (Brinkley et al., 2007; Kaat et al., 2014; Norris et al., 2019).

Statistical Analyses

Changes in teacher- and parent-reported ABC-Hyperactivity, -Irritability, and -Social Withdrawal from ages 9 to 18 were each estimated using multilevel models and maximum likelihood estimation with robust standard errors (MLR) in *Mplus* v. 8.1. Our multilevel structures included age/time (level 1), individual (level 2), and site (level 3). First, null models were used to test whether random effects describing between-participant and between-recruitment site were appropriate (Finch & Bolin, 2017; Luke, 2020). Second, unconditional growth models tested the rate of change (i.e., slope) of ABC-Hyperactivity, -Irritability, and -Social Withdrawal as a function of participant age as a fixed effect. The intercept of the model was set to age 9 for interpretability. Third, we tested if random effects of age (i.e., differences in slope across people) improved model fit using a chi-square difference test based on log-likelihood values and scaling correction factors. Fourth, factors including demographic (e.g., gender, race, caregiver education), individual (e.g., ADOS-CSS, VIQ), and methodological (e.g., consistency in reporter, representing the ratio of participant ABC entries per unique reporter) variables were each tested as predictors of the intercept or slope (i.e., cross-level interactions with age) in the baseline models. Given the clinical relevance of the overlap between ADOS-CSS and VIQ, when these predictor

variables emerged as significant predictors individually, we also tested them simultaneously to isolate the effect of each variable and to test their interaction. The pattern of findings for ADOS-CSS and history of ASD was highly similar; therefore, only ADOS-CSS was retained in models to capture a more fine-grained rating of autism features. Lastly, school-related predictors including teacher type (special or general education teacher), student-adult ratio (ratio of the number of students per adults in the classroom), personal aide (presence of a personal aide for the participant in the classroom), and school type (specialized or mainstream school) were tested in the teacher-reported models. Given that these school-related predictors are time-varying (i.e., can change from year to year), we captured both within-person and between-person effects in our models. Between-person effects were calculated as an average across all available time points. For binary variables, this results in the likelihood of having a score of 1 (e.g., having a personal aide) at any point during the study. In order to determine whether effects of these school-related covariates were maintained after accounting for differences between individual participants, each model was run twice – once without any additional covariates and once including ADOS-CSS and VIQ. Predictor variables were mean-centered for ease of interpretability and plotted in graphs one standard deviation above or below the mean.

Results

Primary Baseline Model Analyses

The null model without predictors revealed that variation in ABC-Hyperactivity, ABC-Irritability, and ABC-Social Withdrawal could be attributed to between-participant differences for teacher-reported (intraclass correlation coefficient (ICC) = 0.523, 0.531, 0.444, respectively) and parent-reported data (ICC = 0.75, 0.75, 0.804, respectively), but not to between-recruitment site differences for teacher-reported (ICC = 0.000, 0.001, 0.002, respectively) or parent-reported data (ICC = 0.000, 0.000, 0.000, respectively). ABC teacher and parent report in the current sample show moderate interrater agreement when tested across multiple time points from ages 9 to 18 years for hyperactivity ($r = .380-.482$) and irritability ($r = .397-.445$), and low interrater agreement for social withdrawal ($r = .097-.252$).

Hyperactivity

Hyperactivity Baseline Models.—The baseline model showed a significant negative trajectory in ABC-Hyperactivity symptoms from late childhood into early adulthood as a function of age, indicating significant improvement over time according to both teacher report ($B = -0.54, p < .001$; see Figure 1a) and parent report ($B = -0.66, p < .001$; see Figure 1b). The random effect of age significantly improved model fit ($p < .001$), indicating significant variability in trajectory of hyperactivity across people based on teacher and parent report.

Predictors of Teacher-Reported Hyperactivity.—When tested individually in the teacher-report models, consistency in reporter, ADOS-CSS, and VIQ all emerged as significant predictors of ABC-Hyperactivity at age 9 (intercept) or change in ABC-Hyperactivity scores from ages 9 to 18 (slope); gender, race, and caregiver education were

not significant predictors of model intercept or slope. Consistency in reporter (i.e., whether the same teacher completed the questionnaire year after year) had a nonsignificant effect on intercept ($B = -0.78, p = .51$) but a significant effect on slope ($B = 0.37, p = .03$; see Figure 2a & Table 2); thus, while participants presented at similar symptom levels at age 9, participants with less consistency in reporters (i.e., many different teachers reporting over time) experienced significantly greater improvement in hyperactivity across time than participants with more consistency in reporters (same reporter/s reporting multiple times). Controlling for VIQ, ADOS-CSS had a significant effect on both intercept ($B = 0.94, p = .03$) and slope ($B = -0.16, p = .02$; see Figure 2b & Table 2), such that participants with higher ADOS-CSS (more ASD features) presented with significantly more teacher-reported hyperactivity at age 9 and experienced significantly greater improvement in teacher-reported hyperactivity over time than participants with lower ADOS-CSS. Controlling for ADOS-CSS, VIQ had a marginal effect on intercept ($B = -0.05, p = .08$) and a significant effect on slope ($B = -0.01, p = .04$; see Figure 2c & Table 2), suggesting that participants with lower VIQs presented with marginally more hyperactivity at age 9 and experienced significantly less improvement in hyperactivity over time than participants with higher VIQs, based on teacher report. The interaction between ADOS-CSS and VIQ had nonsignificant effects on both intercept and slope in the teacher-reported ABC-Hyperactivity model.

Predictors of Parent-Reported Hyperactivity.—When predictors were tested individually in the parent-report ABC-Hyperactivity model, VIQ had a significant inverse effect on intercept ($B = -0.07, p = .01$), but a nonsignificant effect on slope ($B = -0.003, p = .27$; see Figure 2d & Table 2). Consistent with teacher report, participants with lower VIQs presented with significantly more hyperactivity at age 9 than participants with higher VIQs, but in contrast to teacher report, participants with higher and lower VIQs did not differ in their rate of improvement in hyperactivity across time. Gender, race, caregiver education, and consistency in reporter were not significant predictors of parent-reported ABC-Hyperactivity intercept or slope. Additionally, in contrast with findings for teacher report, ADOS-CSS was also not a significant predictor in the parent-reported ABC-Hyperactivity model (see Table 2).

Irritability

Irritability Baseline Models.—The baseline model showed a negative trajectory in ABC-Irritability symptoms from late childhood into early adulthood as a function of age over time according to both teacher report ($B = -0.23, p = .14$; see Figure 1c) and parent report ($B = -0.27, p = .004$; see Figure 1d); although the slope estimates were similar based on teacher and parent report, only parent report reached significance likely due to larger standard errors. A significant random effect of age was identified for both teacher and parent report ($p < .001$), indicating differences in trajectories across people.

Predictors of Teacher-Reported Irritability.—Both participant ADOS-CSS and VIQ had significant effects on teacher-reported ABC-Irritability, though gender, race, caregiver education, and consistency in reporter did not significantly contribute to the variation in teacher-reported ABC-Irritability at age 9 (intercept) or to change in ABC-Irritability scores from ages 9 to 18 (slope). Controlling for VIQ, ADOS-CSS had a significant effect on

intercept ($B = 0.88, p = .01$) and a marginal effect on slope ($B = -0.113, p = .06$; see Figure 3a & Table 2), such that participants with higher ADOS-CSS (more ASD features) presented with significantly more teacher-reported irritability at age 9 and experienced slightly greater improvement in irritability over time than participants with lower ADOS-CSS. Accounting for differences in ADOS-CSS, VIQ had a marginal effect on intercept ($B = -0.05, p = .06$) and a significant effect on slope ($B = -0.01, p = .03$; see Figure 3b & Table 2), suggesting that participants with lower VIQs presented with marginally more irritability at age 9 and experienced significantly less improvement in irritability over time than participants with higher VIQ, based on teacher report. The interaction between ADOS-CSS and VIQ had nonsignificant effects on both intercept and slope in the teacher-reported ABC-Irritability model.

Predictors of Parent-Reported Irritability.—When predictors were tested individually in the parent-report models, VIQ emerged as a significant predictor in the ABC-Irritability model. Similar to teacher-reported findings, VIQ had a significant effect on intercept ($B = -0.04, p = .049$), but in contrast to teacher-reported findings, VIQ had a nonsignificant effect on slope ($B = -0.002, p = .52$; see Figure 3c & Table 2). While participants with lower VIQs presented with significantly more parent-reported irritability at age 9 than participants with higher VIQs, participants did not differ in their rate of improvement in irritability across time. Gender, race, caregiver education, and consistency in reporter were not significant predictors of parent-reported ABC-Irritability intercept or slope. Additionally, in contrast with findings for teacher report, ADOS-CSS was also not a significant predictor in the parent-reported ABC-Irritability model (see Table 2).

Social Withdrawal

Social Withdrawal Baseline Models.—The baseline model showed a nonsignificant and near zero slope of ABC-Social Withdrawal symptoms from late childhood into early adulthood as a function of age according to both teacher report ($B = 0.08, p = .64$; see Figure 1e) and parent report ($B = 0.06, p = 0.49$; see Figure 1f), suggesting that social withdrawal is relatively stable across time. There was significant variability in trajectories of social withdrawal across participants based on teacher and parent report ($p < .001$).

Predictors of Teacher-Reported Social Withdrawal.—Participant ADOS-CSS and VIQ emerged as significant to marginally-significant predictors in the teacher-reported ABC-Social Withdrawal model; conversely, gender, race, caregiver education, and consistency in reporter did not significantly contribute to variation in teacher-reported ABC-Social Withdrawal at age 9 (intercept) or to change in ABC-Social Withdrawal scores from ages 9 to 18 (slope). Per teacher report, controlling for VIQ, ADOS-CSS had a significant effect on intercept ($B = 1.40, p < .01$) and a marginal effect on slope ($B = -0.12, p = .08$; see Figure 4a & Table 2), such that participants with higher ADOS-CSS (more ASD features) presented with significantly more teacher-reported social withdrawal symptoms at age 9 and experienced marginally greater improvement over time than participants with lower ADOS-CSS. Accounting for differences in ADOS-CSS, VIQ had a nonsignificant effect on intercept ($B = 0.004, p = .90$) and a marginal effect on slope ($B = -0.01, p = .10$; see Figure 4b & Table 2) in the teacher-reported social withdrawal model. While participants presented

with similar levels of teacher-reported social withdrawal symptoms at age 9 regardless of VIQ, participants with lower VIQs experienced marginally less improvement in social withdrawal symptoms over time than participants with higher VIQs.

Predictors of Parent-Reported Social Withdrawal.—When predictors were tested individually, ADOS-CSS and VIQ emerged as significant predictors in the parent-reported ABC-Social Withdrawal model, though gender, race, caregiver education, and consistency in reporter failed to reach significance. Upon entering ADOS-CSS and VIQ into the model simultaneously to account for the clinical overlap, only ADOS-CSS emerged as a significant predictor of ABC-Social Withdrawal. Controlling for VIQ, ADOS-CSS had a significant effect on intercept ($B = 0.56, p < .01$) but a nonsignificant effect on slope ($B = -0.004, p = 0.89$; see Figure 4c & Table 2) of parent-reported social withdrawal. Consistent with teacher report, participants with higher ADOS-CSS (more ASD features) presented with significantly more parent-reported social withdrawal symptoms at age 9 than participants with lower ADOS-CSS, though, in contrast to teacher report, displayed similar rates of parent-reported improvement in social withdrawal from ages 9 to 18 regardless of ADOS-CSS. Controlling for ADOS-CSS, VIQ was not a significant predictor of parent-reported ABC-Social Withdrawal intercept ($B = -0.03, p = 0.15$) or slope ($B = -0.002, p = 0.45$; see Table 2). Furthermore, the interaction between ADOS-CSS and VIQ had nonsignificant effects on both intercept and slope in the parent-reported ABC-Social Withdrawal model.

School-Related Predictors of Teacher-Reported Maladaptive Behaviors

School-Related Predictors of Hyperactivity.—Teacher type (special or general education teacher) emerged as a significant predictor of teacher-reported ABC-Hyperactivity slope ($B = 1.21, p = .02$) but not intercept ($B = 2.12, p = .54$). The within-person effect of teacher type was not significant. This indicates that while participants with special and general education teachers presented with similar levels of hyperactivity at age 9, participants who tended to have special education teachers improved significantly less over time in hyperactivity than participants who were more likely to have general education teachers. When accounting for between-participant differences in ADOS-CSS and VIQ, the effect of teacher type became nonsignificant (see Table 2). Student-adult ratio, school type, and the presence of a personal aide did not have significant effects on intercept or slope of teacher-reported hyperactivity, with and without controlling for ADOS-CSS and VIQ (see Table 2).

School-Related Predictors of Irritability.—Teacher type emerged as a significant predictor of teacher-reported ABC-Irritability slope ($B = 1.02, p = .01$) but not intercept ($B = 1.95, p = .45$), and no within-person effect was detected. Thus, while participants with special and general education teachers presented with similar levels of irritability at age 9, participants who were more likely to have special education teachers improved significantly less over time than participants who tended to have general education teachers. When accounting for ADOS-CSS and VIQ, the effect of teacher type became nonsignificant (see Table 2). Additionally, student-adult ratio (ratio of the number of students per adults in the classroom) emerged as a significant predictor of ABC-Irritability intercept ($B = 0.57, p < .01$) and slope ($B = -0.08, p < .03$), but no within-person effect emerged. Therefore,

participants who were more likely to be in classrooms with higher student-adult ratios (more students per adults) presented with higher levels of teacher-reported irritability at age 9 and experienced greater improvement in irritability over time compared to participants who tended to be placed in classrooms with lower student-adult ratios (fewer students per adults). When accounting for ADOS-CSS and VIQ, the effect on intercept dropped to marginal significance ($B = 0.40, p = .06$) and the effect on slope became nonsignificant ($B = -0.06, p = .12$; see Figure 5a & Table 2). Lastly, school type (specialized or mainstream school) emerged as a significant predictor of ABC-Irritability intercept ($B = -6.39, p < .01$) but not slope ($B = 0.27, p = .49$), and no within-person effect was noted. Thus, participants who were more likely to be in specialized schools presented with greater teacher-reported irritability at age 9 than participants who tended to be in mainstream schools, though both groups experienced similar improvement in irritability over time. When accounting for ADOS-CSS and VIQ, the effect of school type on intercept dropped to marginal significance ($B = -4.24, p = .09$; see Figure 5b & Table 2). The presence of a personal aide did not have an effect on intercept or slope of teacher-reported irritability, both when including and excluding ADOS-CSS and VIQ (see Table 2).

School-Related Predictors of Social Withdrawal.—School type emerged as a significant predictor of ABC-Social Withdrawal slope ($B = -0.90, p < .03$) but not intercept ($B = 1.25, p = 0.62$). Thus, participants who tended to be placed in a specialized school experienced increasing (i.e., worsening) social withdrawal symptoms over time compared to participants who were likely to be placed in a mainstream school, though they demonstrated similar levels of teacher-reported social withdrawal at age 9. A within-person effect of school type was significant ($B = 2.27, p < .05$), such that within-person change from a specialized school to a mainstream school was related to an increase in social withdrawal symptoms. When accounting for ADOS-CSS and VIQ, these effects of school type on teacher-reported social withdrawal remained significant (between-person slope: $B = -1.01, p = .03$, see Figure 5c & Table 2; within-person effect: $B = 2.44, p = .03$), suggesting that these school type effects on teacher-reported social withdrawal persist even after controlling for individual-level differences. Teacher type, student-adult ratio, and the presence of a personal aide did not have significant effects on intercept or slope of social withdrawal (see Table 2).

Discussion

The present study extends the field's understanding of changes in and predictors of maladaptive behavior trajectories among individuals with ASD and non-ASD developmental delays from teacher, as well as parent, perspectives. Findings revealed an overall pattern of improvement from late childhood into adolescence in many, although not all, maladaptive behaviors. Specifically, according to both teacher and parent report, participants showed the greatest improvement in hyperactivity, some improvement in irritability, and stable levels of social withdrawal from ages 9 to 18. This is the first study, to the authors' knowledge, to track changes in maladaptive behaviors over time from teacher perspectives and to document consistency in *trajectory patterns* of maladaptive behaviors across teacher and parent report.

This multi-informant study provides insight into maladaptive behavioral patterns across different contexts over time. Teachers and parents showed moderate interrater agreement on

reports of hyperactivity and irritability symptoms, and low interrater agreement on reports of social withdrawal symptoms. Although literature on teacher-parent agreement is somewhat mixed, studies generally identify low-to-moderate correlations (Freund & Reiss, 1991; Lane et al., 2013; Stratis & Lecavalier, 2015, 2017), with better agreement on externalizing vs. internalizing constructs likely due to the observability of these behaviors (Kanne et al., 2009; Palmer et al., 2022; Stratis & Lecavalier, 2015). Perhaps most notably, teacher and parent report revealed the same *pattern of trajectories*, and predictors of those trajectories, for all three kinds of maladaptive behaviors. Consistency of trajectories, primarily for hyperactivity and irritability, for teachers and parents further supports the idea that these identified patterns are accurate representations of participants' behavior over time. It also provides evidence that behaviors (particularly hyperactivity and irritability) may change in similar ways across school and home contexts, which involve different settings, situations, and social circumstances.

The improvements in hyperactivity and irritability, according to both teacher and parent report, are commensurate with the trend of improvement in behavioral functioning over time in ASD (Anderson et al., 2011, 2014; Seltzer et al., 2004; Shattuck et al., 2007; Stringer et al., 2020; Woodman et al., 2015). It may be that developmental improvements in self-regulation that come online as children age (Cibralic et al., 2019; Greenlee et al., 2021; Shattuck et al., 2007), coupled with environmental supports from teachers and parents (Beck et al., 2020; Ting & Weiss, 2017; Woodman et al., 2015), lead to better management of behaviors such as impulsivity, distractibility, tantrums, and aggression over time. The lack of improvement in social withdrawal symptoms over time, based on both teacher and parent report, broadly aligns with the existing literature. Research suggests that social withdrawal in ASD is associated with greater difficulties with friendships, increased feelings of loneliness, and more depressive symptoms (Anderson et al., 2011; Ooi et al., 2016). The persistent nature of social withdrawal over time may be due to a bidirectional process in which individuals with ASD who are more socially withdrawn may be at greater risk for loneliness and depression, which may in turn lead to continued withdrawal. Of note, while some of the items within the social withdrawal ABC domain may overlap or be directly related to autism features (e.g., prefers to be alone), this may not always be the case (e.g., social motivation varies across autistic people; Jaswal & Akhtar, 2019; Mundy, 2019).

There was significant variability in hyperactivity, irritability, and social withdrawal trajectories based on individual-level predictors. Broadly, our effects of ASD features and VIQ align with existing parent-report findings in the literature (Beadle-Brown et al., 2006; McTiernan et al., 2011; Seltzer et al., 2004; Shattuck et al., 2007). More specifically, based on teacher report, participants with more autism features presented with more hyperactivity, irritability, and social withdrawal at age 9 and tended to experience greater improvement in these symptoms over time than participants with fewer ASD features. Notably, this pattern may be due to the fact that participants who present with more maladaptive behaviors at age 9 have more room for improvement over time. Similarly, participants with lower VIQs presented with more hyperactivity and irritability at age 9, though, in contrast to the effects of severity of autism behaviors, they experienced less improvement in hyperactivity, irritability, and social withdrawal across time compared to participants with higher VIQs, based on teacher report. It may be that those with minimal or no language struggle to

effectively communicate their wants and needs, which may lead to less improvement in maladaptive behaviors over time (Matson et al., 2008; Tager-Flusberg & Kasari, 2013; Turygin et al., 2013). The differential effects VIQ and ASD features on slope may be partially related to the fact that VIQ itself tends to be relatively more stable over time than ASD features (Begovac et al., 2009; Seltzer et al., 2004). Individuals who start out with greater autism features may actually improve in those features in tandem with changes in maladaptive behaviors, leading to an accelerated improvement in maladaptive behaviors over time.

Interestingly, more slope effects (i.e., differences in rates of change based on VIQ or ASD features) were identified via teacher report than parent report; it may be that such individual differences matter more over time in the school setting than at home. Perhaps, this is due to teachers having many students in their classroom and rotating through new students regularly and, thus, having more reference points by which to rate a child's behavior. In contrast, parents generally have fewer children for comparison. Additionally, parents typically have daily contact with their children for decades and may therefore have a more stable view of their child, while having different teachers reporting on the child's behavior over time may be more sensitive to such changes, particularly for those with more autism features. This idea is supported by our findings that those with more teachers reporting on their behavior over time demonstrate greater change in hyperactivity, although we cannot say which report is more accurate.

Our exploration of school-related predictors of maladaptive behavior trajectories revealed that being more likely to have a special education teacher, learn in a classroom with a lower student-adult ratio, or attend a specialized school was associated with greater severity of and/or less improvement over time in maladaptive behaviors (i.e., hyperactivity and/or irritability). Notably, these effects either became nonsignificant or dropped to marginal significance upon controlling for differences in autism symptom severity and VIQ. This suggests that these school-related effects are likely driven by individual differences between students, as opposed to differences in the school or classroom environments. That is, individuals with higher support needs (i.e., greater autism symptom severity, lower VIQ, more maladaptive behaviors) have a greater likelihood of working with a special education teacher in the classroom, learning in a classroom with fewer students per adults, and attending a specialized school, and may require increased individualized adult support (Gibb et al., 2007; Simpson et al., 2003; Vaughn et al., 1996).

Related to social withdrawal, participants who were more likely to be placed in a mainstream school experienced greater improvement in social withdrawal symptoms over time compared to those in a specialized school who experienced increasing (i.e., worsening) social withdrawal symptoms over time. This finding aligns with existing research showing the benefits of appropriate social and behavioral modeling by typically developing peers for students with ASD and non-spectrum delays (Chamberlain et al., 2007). Perhaps, an exposure-type process may also be at play; greater access to other peers may offer more opportunities for observing and engaging in social approach behaviors which may, in turn, lead to less fear or hesitancy about social interactions, more successful social interactions, and reduced social withdrawal symptoms. On an individual level, however,

transitioning from a specialized school to a mainstream school was related to a within-person increase in social withdrawal. Difficulties associated with the transition across school types may hinder the social benefits of mainstream education placement. Specifically, the transition from a specialized to a mainstream school may be characterized by increased social demands coupled with decreased social support, uncertainty in navigating complex social environments, difficulty connecting and relating to peers, and increased awareness of differences through social comparisons (Chamberlain et al., 2007; Zainal & Magiati, 2019). In response to these challenges, individuals with ASD and other delays may exhibit increased behavioral challenges, followed by greater peer rejection and/or fewer opportunities for social relationships, which may ultimately result in heightened social withdrawal and isolation (Symes & Humphrey, 2010).

The present study has important implications for clinical practice. Although much intervention work has been devoted to the treatment of challenging behaviors in ASD (Montgomery et al., 2014; Tevis & Matson, 2022), our study highlights specific areas of clinical need. Given the consistent pattern of teacher- and parent-reported maladaptive behaviors over time, there is a need for multi-system interventions to improve functioning across settings. By supporting teachers in managing maladaptive behaviors at school, it is possible that improvements in behaviors may have spill-over effects into home functioning and vice versa. Furthermore, considering the stable trajectory of social withdrawal and the impact of social withdrawal on well-being and quality of life in ASD (Anderson et al., 2011; Kapp et al., 2011), promoting social approaches may be a particularly important intervention target beyond childhood and into adolescence. Additionally, despite the pattern of improvement in hyperactivity and irritability over time, interventions should continue to address these symptoms throughout development given the functional impairment caused by these symptoms (De Bildt et al., 2005; Kim et al., 2000) well beyond early childhood. Furthermore, given that youth with more ASD features and lower VIQs demonstrated more maladaptive behaviors, providers should carefully assess for co-occurring maladaptive behaviors/conditions in patients with this diagnostic and cognitive profile and consider these co-occurring behaviors in intervention planning.

In addition to the strengths of this study including the use of a multi-informant approach and longitudinal design, there are limitations that highlight directions for future research. Participants in our study were primarily referred for diagnosis under age 3; our findings may not be representative of children diagnosed with ASD at later ages. Additionally, characteristic of most longitudinal studies, attrition has affected the sample with increased participant dropout noted among participants from marginalized communities. Although the sample size is suitable for the present study, findings should be replicated with larger and more representative samples to bolster confidence in these conclusions. Furthermore, the ABC has limitations inherent in informant-report measures; future work may wish to include a clinical interview to provide more in-depth characterization of such maladaptive behaviors. Relatedly, as with any measure, there is likely some degree of error around the metrics of the ABC domain scores, ADOS-CSS, and VIQ scores that are important to consider. Lastly, predictors of maladaptive behaviors that are outside the scope of the present study may be fruitful for future research to explore including, for example, intervention history and broader family-level factors (e.g., siblings, family cohesion, stress).

Conclusion

This longitudinal study aimed to examine trajectories of teacher- and parent-reported maladaptive behaviors, as well as predictors of these trajectories, from late childhood through early adulthood among individuals with ASD and non-spectrum early developmental delays. Over this timespan, results highlight a consistent pattern of improvement in hyperactivity and irritability, and minimal change in social withdrawal, across both teacher and parent report. Higher VIQ, fewer autism features, and mainstream school placement emerged as important individual- and school-related differences linked with fewer maladaptive behaviors over time. The multi-informant approach and longitudinal design provide novel insight into the manifestations of these maladaptive behaviors across different contexts and across time and can be used to inform clinical practice.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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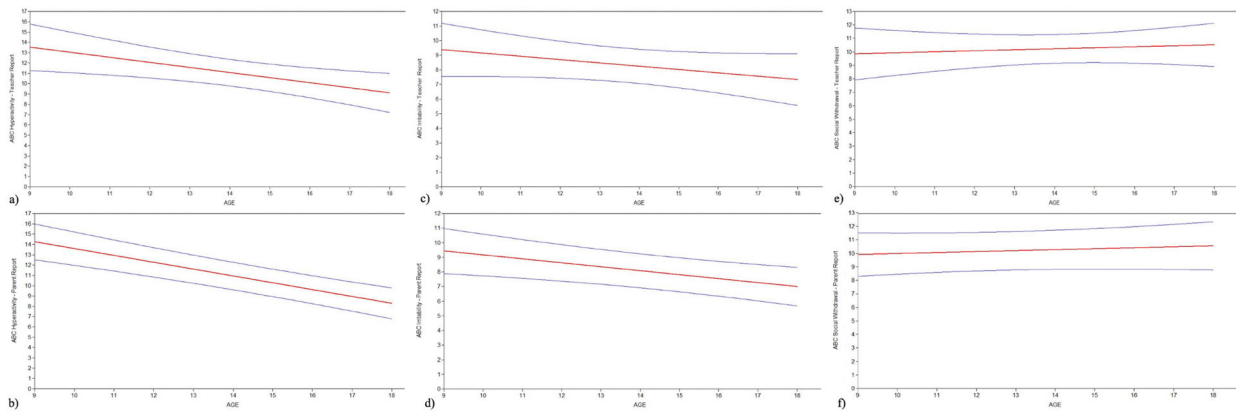


Figure 1.
Teacher- and Parent-Reported Baseline Trajectories.

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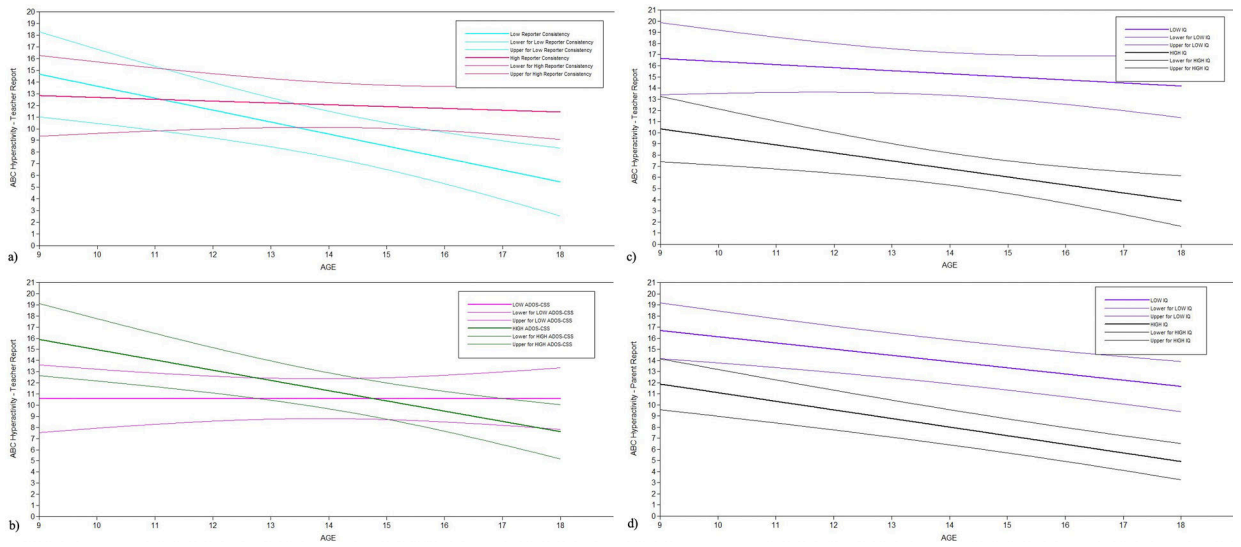


Figure 2.
Predictors of Teacher- and Parent-Reported ABC-Hyperactivity Trajectories.

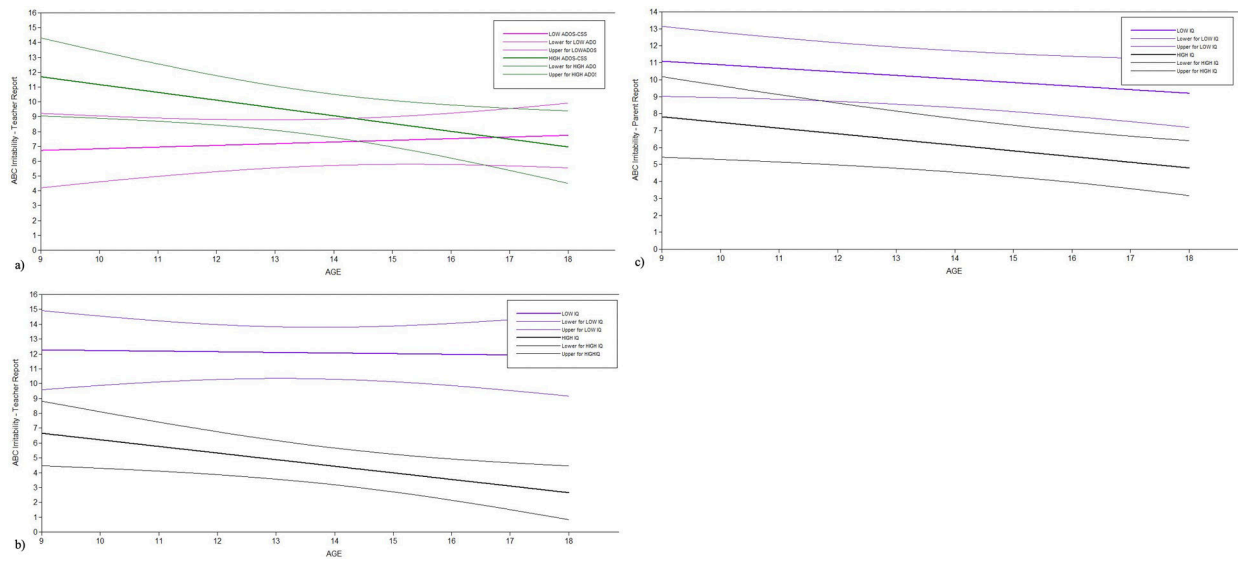


Figure 3.
Predictors of Teacher- and Parent-Reported ABC-Irritability Trajectories.

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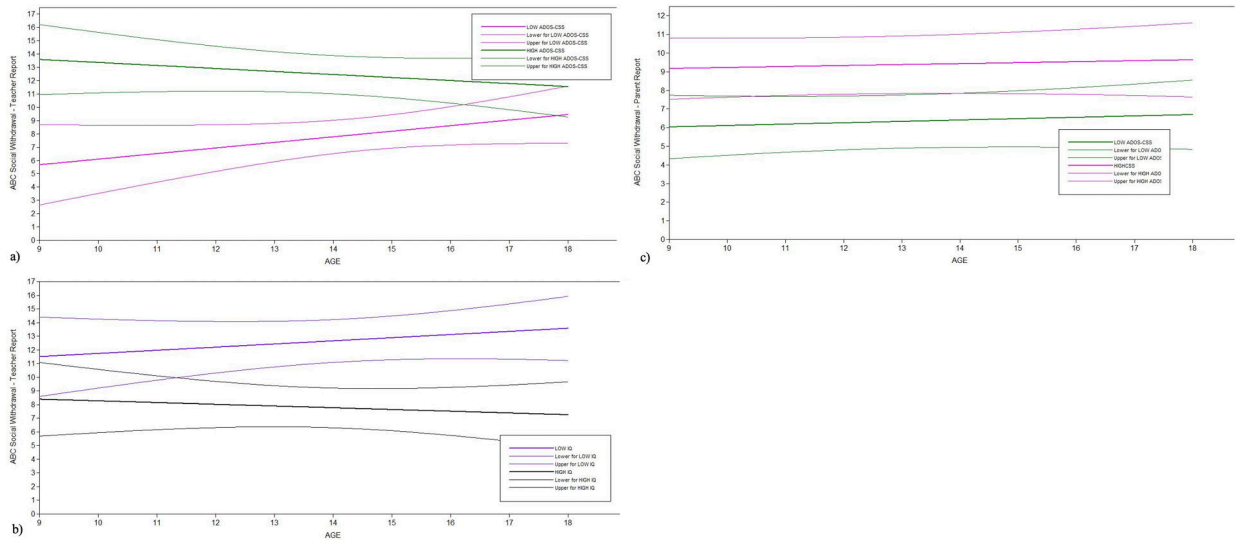


Figure 4.
Predictors of Teacher- and Parent-Reported ABC-Social Withdrawal Trajectories.

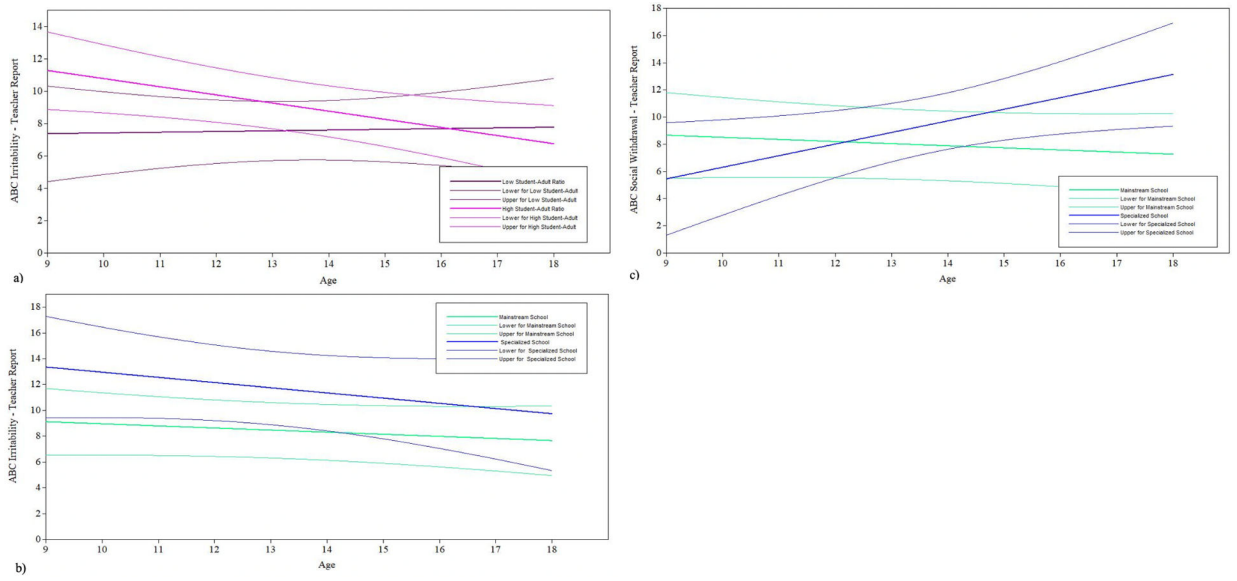


Figure 5.
School-Related Predictors of Maladaptive Behavior Trajectories.

Table 1.

Sample demographic and diagnostic characteristics.

	<i>(N = 165)</i>
Male, <i>n</i> (%)	131 (79.4)
White, <i>n</i> (%)	124 (75.2)
Caregiver education	
College degree or above, <i>n</i> (%)	79 (47.9)
Site, <i>n</i> (%)	
North Carolina	86 (52.1)
Illinois	51 (30.9)
Michigan	28 (17)
ASD dx, <i>n</i> (%)	130 (78.8)
ADOS-CSS, <i>M</i> (<i>SD</i>)	6.18 (2.84)
VIQ, <i>M</i> (<i>SD</i>)	56.42 (37.5)

ASD dx: autism spectrum disorder diagnosis (diagnostic history); ADOS-CSS: Autism Diagnostic Observation Schedule-Calibrated Severity Score; VIQ: verbal intelligence quotient; *M*: mean; *SD*: standard deviation

Table 2. Individual-, methodological-, and school-related predictors of teacher- and parent-reported trajectories.

Predictors	Hyperactivity			Irritability			Social Withdrawal				
	Teacher B on Int.	Within- Person Effect	Parent B on Slope Int.	Teacher B on Slope Int.	Within- Person Effect	Parent B on Slope Int.	Teacher B on Slope Int.	Within- Person Effect	Parent B on Slope Int.		
Individual- Related Predictors											
ADOS-CSS	0.94*	-0.16*	-0.02	0.88*	-0.11 [^]	0.41	-0.004	1.40**	-0.12 [^]	0.56**	-0.004
VIQ	-0.05 [^]	-0.01*	-0.003	-0.05 [^]	-0.01*	-0.04*	-0.002	0.004	-0.01 [^]	-0.03	-0.002
Methodological Predictors											
Consistency in Reporter	-0.78	0.37*	—	0.55	0.07	—	—	0.68	0.03	—	—
Student- Adult Ratio	0.18	-0.04	0.01	0.40 [^]	-0.06	—	—	0.22	-0.02	-0.002	—
School-Related Predictors											
Teacher Type	-0.55	0.88	-1.41	-0.34	0.64	—	—	-0.71	0.42	-0.90	—
School Type	-2.72	0.35	-1.99	-4.24 [^]	0.24	—	—	3.20	-1.01*	2.44*	—
Personal Aide	4.73	-0.44	-0.40	2.18	-0.41	0.29	—	0.37	0.08	0.28	—

Note.

** $p < .01$;

* $p < .05$;

[^] $p < .10$

Int.: Intercept; ADOS-CSS: Autism Diagnostic Observation Schedule-Calibrated Severity Score; VIQ: verbal intelligence quotient