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Parental sleep quality and behavior problems of children with autism

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Abstract

This study explored the impact of parental sleep quality on the experience of behavior problems by children with autism spectrum disorder. A 14-day daily diary was used in a sample of 176 mother–father couples. Dyadic multilevel models were conducted to examine the between-person and within-person effects of previous-night sleep quality on parents' rating of level of behavior problems by the child with autism spectrum disorder and level of positive and negative affect. Results indicated that persistently poor sleep quality was associated with between-person differences in initial rating of level of behavior problems by the child with autism spectrum disorder for mothers. At a within-person level, previous-night sleep quality moderated the association between rating of level of behavior problems by the child with autism spectrum disorder and level of positive and negative affect in fathers. Child-related stressors exerted less influence on fathers' affect following a day with poor sleep quality. Interventions aimed at enhancing sleep quality in parents of children with autism spectrum disorder may have important effects on parental psychological well-being.

Keywords

autism; behavior problems; parent; parenting stress; sleep

Children with autism spectrum disorder (ASD) present with a host of clinically significant co-occurring behavior problems (e.g. inattention and anxious affect), in addition to impairments in social communication, restricted/repetitive interests and behaviors, and sensory sensitivities (Choi and Kovshoff, 2013; Hartley et al., 2008). These behavior problems are particularly stressful on parents and are strong predictors of psychological well-being for both mothers and fathers (Hartley et al., 2012; Lecavalier et al., 2006). Yet, little research has examined the extent to which parental circumstances influence the experience of child-related stressors, such as the level of behavior problems by the child with ASD. In the general population, poor sleep quality has been shown to contribute to the occurrence of stressors and to a reduced ability to cope with stressors (Doane and Thurston, 2014). Parents of children with ASD are at risk for poor sleep quality (Lopez-Wagner et al., 2008; Meltzer, 2008), yet virtually nothing is known about whether poor sleep quality

contributes to parental perceptions of the level of behavior problems by the child with ASD and/or whether poor sleep quality reduces coping resources, such that parents are more sensitive to the negative impact of these behavior problems. The goal of this study was to examine the between-person and within-person associations between parents' previous-night sleep quality, their rating of the level of behavior problems by the child with ASD, and their daily positive and negative affect, in a sample of 176 mother–father couples.

Only a handful of studies have examined sleep quality in parents of children with ASD. These studies indicate that compared to parents of typically developing children, parents of children with ASD report poorer sleep quality (e.g. wake earlier and less sleep) (Lopez-Wagner et al., 2008; Meltzer, 2008). In part, the poor sleep quality of parents of children with ASD may be the result of the sleep problems of their child with ASD; studies indicate that 44%–83% of children with ASD regularly experience sleep problems (Meltzer and Mindell, 2008). The heightened level of parenting stress (Hayes and Watson, 2013) and increased rate of mental health problems (Totsika et al., 2011) experienced by these parents may additionally contribute to parents' sleep problems.

There is substantial evidence documenting a sleep-stress cycle; specifically, research on the general population indicates that the experience of stress contributes to poor sleep quality and poor sleep quality further contributes to stress. Indeed, poor sleep quality is associated with a reduced ability to regulate emotions, cognitions, and behaviors, resulting in poor judgment, distractibility, slowed information processing, irritability, and hasty behaviors, all of which elicit stressful experiences (Basner et al., 2013; Doane and Thurston, 2014; Vandekerckhove and Cluydts, 2010). In the context of parenting a child with ASD, poor sleep quality may contribute to the experience of child-related stressors, including the level of behavior problems by the child with ASD. Specifically, parents experiencing poor sleep quality may perceive behavior problems as being more frequent and severe, given drained resources. Parents may also elicit a higher level of behavior problems by the child with ASD, as a result of less attentive, patient, and engaged parenting behaviors. Moreover, parents experiencing poor sleep quality may be less able to cope with behavior problems by the child with ASD, due to their reduced ability to regulate emotions, cognitions, and behaviors. Thus, following a night with poor sleep quality, parents may be more sensitive (moderating effect) to the negative impact of the child with ASD's behavior problems, such that these behavior problems take a heavier toll on parental psychological well-being. The effect of poor sleep quality may operate at both a between-person level (across parents) and a within-person level (one day to the next) in explaining the variability in rating of level of behavior problems by the child with ASD, and also in the association between level of behavior problems by the child with ASD and parental psychological well-being.

This study used a 14-day daily diary to examine the impact of parents' previous-night sleep quality on their rating of level of behavior problems by the child with ASD and daily psychological well-being (positive and negative affect), in a sample of 176 mother–father couples, within a natural context. Specific study aims were to (1) examine the association between parents' previous-night sleep quality and their rating of level of behavior problems by the child with ASD at a between-person (across parents) and within-person (across the 14 days for each parent) level and (2) evaluate whether at a within-person, day-to-day level,

parents' previous-night sleep quality moderates the relation between rating of level of behavior problems by the child with ASD and parents' level of positive and negative affect. We hypothesized that parents with lower global sleep quality would have a higher initial rating of level of behavior problems by the child with ASD than parents with higher global sleep quality. At a within-person, day-to-day level, previous-night sleep quality was predicted to be negatively associated with the rating of level of behavior problems by the child with ASD. Moreover, rating of level of behavior problems by the child with ASD was predicted to co-vary with parents' level of positive (positive association) and negative (negative association) affect. We hypothesized that parents' previous-night sleep quality would moderate this association; specifically, level of behavior problems by the child with ASD would have a stronger association with parents' level of positive and negative affect following a night with low rather than high sleep quality.

Method

Sample

Participants were involved in Time 1 of an ongoing longitudinal study in Midwestern, United States. The study included 182 mother–father couples ($N = 364$ parents) with a child with ASD. Participants were recruited through flyers mailed to families of children with an educational label of ASD, research registries, and postings at ASD organizations (e.g. local chapters of Autism Society). Eligibility criteria included having a child with ASD (5–12 years) and being in a partner relationship (≥ 3 years), in which both partners agreed to be in the study. From this larger sample, both partners from 176 couples took part in the 14-day daily diary and were included in analyses. Parents opting out of the diary did not significantly differ from the parents who completed the diary in parent (age, education, race/ethnicity, or income) or child (age, level of behavior problems, or severity of ASD symptoms) characteristics. In all, 12 couples had multiple children with ASD; the oldest child with ASD was the study focus. Parents provided documentation of ASD diagnoses via medical or educational records (including Autism Diagnosis Observation Schedule (ADOS; Lord et al., 2000)). The child with ASD was adopted in four families (≥ 5 years prior). Three couples were unmarried (lived together for ≥ 8 years). In 13 couples, one parent was a stepparent. Table 1 presents additional socio-demographics. On the Social Responsiveness Scale (SRS2; Constantino and Gruber, 2012), 112 children (64%) had ASD symptoms in the severe range (Total T-score ≥ 76). On the Child Behavior Checklist (CBCL; Achenbach and Rescorla, 2001), 76 children (43%) had clinically significant behavior problems (Total T-score ≥ 70). On the Adaptive Behavior Assessment System (ABAS2; Harrison and Oakland, 2003), 121 children (69%) had marked impairment in adaptive behavior (General Adaptive Composite ≥ 70).

Procedure

Mothers and fathers independently completed questionnaires about family socio-demographics and the child with ASD, and a daily diary (10–15 min/entry), via online surveys (94%) or an iPod Touch (6%), for 14 consecutive days. The day/time of each diary entry was recorded. Entries spaced 20–26 h apart, that included previous-night sleep quality

rating and that day's level of behavior problems by the child with ASD, were included (98.1% of entries). Parents were compensated US\$75.

Measures

Child and parent socio-demographics—Mothers and fathers reported on socio-demographics. Child gender was coded 0 = “male,” 1 = “female.” Child age was coded in years. Intellectual disability (ID) was reported and confirmed via medical and educational records (0 = “no ID,” 1 = “ID”). Mothers and fathers individually rated the severity of child ASD symptoms using the SRS2, which has previously been shown to have high internal consistency (Bruni, 2014), and had high internal consistency in our sample (Cronbach's $\alpha = 0.86$). Parent gender was coded 0 = “mother” and 1 = “father.” Parent education level was coded 0 = “<high school,” 1 = “high school degree/GED,” 2 = “some college,” 3 = “college degree,” 4 = “some graduate school,” and 5 = “graduate/professional degree.” Household income was coded 1 = “US\$9999” to 14 = “US\$160,000,” increasing by US\$9999 increments. Given limited diversity, race/ethnicity was not included in models.

Positive and negative affect—The Positive and Negative Affect Scale (PANAS; Watson et al., 1988) includes 20 items that assess 10 positive (e.g. enthusiastic) and 10 negative (e.g. distressed) affective states, rated 1 = “none of the time” to 5 = “all of the time.” Items are summed to create a total positive and negative affect scores; higher scores indicate higher levels of positive and negative affect. The PANAS was previously shown to have good reliability and factorial validity (Watson and Clark, 1997) and had high internal consistency in our sample (Cronbach's $\alpha = 0.92$ and 0.88).

Child behavior problems—The Scales of Independent Behavior–Revised (SIB-R; Bruininks et al., 1996), modified to capture the previous 24 h, was completed by parents every day of the diary. Behavior problems included the following: hurtful to himself/herself, destructive/hurtful to others, destructive to property, disruptive behavior, unusual or repetitive habits, socially offensive behavior, withdrawn/inattentive behavior, uncooperative behavior, and others. Frequency (coded 1 = “occurred” vs 0 = “did not occur”) and severity (1 = “not serious” to 5 = “extremely serious”) were multiplied. This modified SIB-R had good reliability in mothers of grown children with ASD (Seltzer et al., 2010), and high internal reliability in our sample (Cronbach's $\alpha = 0.81$). Mean level of behavior problems ($M = 3.30$, $SD = 5.74$) was significantly correlated with the CBCL Total T-score ($r = 0.53$, $p < 0.001$).

Previous-night sleep quality—Mothers and fathers rated previous-night sleep quality from 1 = “very good” to 7 = “very poor.” This single item has been used in previous diary studies (Cappelleri et al., 2009; Ong et al., 2013), and is a component of the Pittsburgh Sleep Quality Index (Buysse et al., 1989). This single item was shown to have strong convergent validity with multiple-item measures of sleep quality (Cappelleri et al., 2009). In our sample, this item was significantly positively associated with hours slept at a within-person level ($r = 0.22$, $p < 0.001$).

Data analysis plan

Descriptive statistics and within-couple associations were used to examine parents' previous-night sleep quality and their rating of level of behavior problems by the child with ASD, and level of positive and negative affect. Dyadic multilevel models (MLM) using hierarchical linear modeling (Raudenbush et al., 2011) were used to account for the within-person nested structure of diary data, and the dyadic nature of couple data (mothers and fathers, within-couples) (Bolger and Laurenceau, 2013). Intercept-only models were tested first, followed by full models.

To address the first study aim, a dyadic MLM predicting parents' rating of level of behavior problems by the child with ASD was conducted. Level 1 variables included mother (1 = "mother," 0 = "father"), father (1 = "father," 0 = "mother"), mother time (0–13), father time (0–13), mother previous-night sleep quality, and father previous-night sleep quality. The intercept was removed at Level 1, and included at Level 2 separately for the mother and father variables (Bolger and Laurenceau, 2013). Level 2 variables included parent (income and education) and child (age, ID status, and severity of ASD symptoms) socio-demographics. In addition, the mean previous-night parental sleep quality (average across 14 days) was included at Level 2 to examine and control for global sleep quality.

For the second study aim, dyadic MLMs predicting parents' level of positive and negative affect were conducted with Level 1 variables of mother (1 = "mother," 0 = "father"), father (1 = "father," 0 = "mother"), mother time (0–13), father time (0–13), mother previous-night sleep quality, father previous-night sleep quality, mother rating of level of behavior problems by the child with ASD, and father rating of level of behavior problems by the child with ASD. The intercept was removed at Level 1, and included at Level 2 separately for the mother and father variables. An interaction of previous-night sleep quality $\times$ level of behavior problems by the child with ASD was also entered at Level 1 for mothers and fathers. Level 2 variables included parent and child socio-demographics. Mean level of behavior problems by the child with ASD (global behavior problems) and mean previous-night sleep quality (global sleep quality) were included at Level 2 to examine and control for between-person effects. Level 1 continuous variables were group-mean centered. Level 2 dichotomous variables were un-centered and continuous variables were grand-mean centered.

Results

Descriptive statistics

Parents completed an average of 13.53 ($SD = 2.75$) days of the 14-day daily diary. Intercept-only dyadic MLMs examined mother–father differences and within-person, day-to-day, variability in previous-night sleep quality, level of behavior problems by the child with ASD, and level of positive and negative affect. Mothers ($M = 3.72$, $SE = 0.07$) reported significantly higher mean level of previous-night sleep quality (global sleep quality) than fathers ($M = 3.61$, $SE = 0.07$), $\chi^2(1) = 4112.72$, $p < 0.001$. Mothers ($M = 6.68$, $SE = 0.40$) also reported a significantly higher mean level of behavior problems (global behavior problems) by the child with ASD than fathers ($M = 4.46$, $SE = 0.32$) ($\chi^2(1) = 301.43$, $p <$

0.001). In addition, mothers ($M = 26.72$, $SE = 0.47$) reported significantly lower levels of positive affect than fathers ($M = 28.53$, $SE = 0.50$) ($\chi^2(1) = 5136.42$, $p < 0.001$). Mothers ($M = 15.28$, $SE = 0.27$) also reported significantly higher levels of negative affect than fathers ($M = 14.34$, $SE = 0.29$) ($\chi^2(1) = 4469.66$, $p < 0.001$). There were significant positive within-couple correlations across the 14 days in previous-night sleep quality ($r = 0.27$, $p < 0.01$), level of behavior problems by the child with ASD ($r = 0.60$, $p < 0.01$), positive affect ($r = 0.27$, $p < 0.01$), and negative affect ($r = 0.26$, $p < 0.01$). There was significant within-person variability in previous-night sleep quality, level of behavior problems by the child with ASD, and level of positive and negative affect for mothers and fathers. Intra-class correlation coefficients for the unconditional models indicated 15% of variance in level of behavior problems by the child with ASD, 26% in level of positive affect, and 16% in level of negative affect occurred at Level 1 (variability across the 14 days for each parent). Thus, the majority of variance occurred at the between-person level.

Previous-night sleep quality and behavior problems

Table 2 presents the full dyadic MLM predicting daily rating of level of behavior problems by the child with ASD. At a between-person level (Level 2), mothers who had a child with ASD and ID ($\beta = 1.48$, $p = 0.05$), mothers who had a child with a higher severity of ASD symptoms ($\beta = 0.07$, $p < 0.001$), and mothers with a lower mean previous-night sleep quality (global sleep quality) ($\beta = 0.80$, $p = 0.02$) reported a higher initial level of behavior problems by the child with ASD. At the between-person level (Level 2), fathers who had a younger child with ASD ($\beta = -0.35$, $p < 0.01$) and fathers who had a child with a higher severity of ASD symptoms ($\beta = 0.06$, $p < 0.001$) reported a higher initial level of behavior problems by the child with ASD.

With parent and child socio-demographics at their mean, and controlling for the between-person effect of mean previous-night sleep quality (global sleep quality), there was no significant within-person, day-to-day (Level 1), effect of previous-night sleep quality on rating of level of behavior problems by the child with ASD for mothers or fathers. In other words, fluctuations in previous-night sleep quality did not predict parents' rating of level of behavior problems by the child with ASD across the 14 days.

Previous-night sleep quality and positive and negative affect

Table 3 presents the full dyadic MLMs predicting parents' daily level of positive and negative affect. Between-persons (Level 2), mothers who had a child with ASD and ID ($\beta = 1.99$, $p = 0.04$) and mothers who had a higher mean previous-night sleep quality (global level of sleep quality) ($\beta = -1.31$, $p < 0.01$) reported a higher initial level of positive affect. Fathers who had an older child with ASD ($\beta = 0.47$, $p = 0.02$), fathers who had a child with a lower severity of ASD symptoms ($\beta = -0.04$, $p = 0.03$), and fathers who had a higher mean previous-night sleep quality (global sleep quality) ($\beta = -1.37$, $p < 0.01$) reported a higher initial level of positive affect.

With parent and child socio-demographics at their mean, and after controlling for between-person effects of mean level of behavior problems by the child with ASD (global behavior problems) and mean previous-night sleep quality (global sleep quality), higher previous-

night sleep quality predicted a higher level of positive affect at a within-person, day-to-day, level for both mothers ($\beta = -1.09, p < 0.001$) and fathers ($\beta = -1.00, p < 0.001$). In other words, parents reported a higher level of positive affect following a night with high sleep quality. Moreover, at the within-person level, fluctuations in previous-day rating of level of behavior problems ($\beta = -0.20, p < 0.01$) by the child with ASD predicted change in fathers' level of positive affect. Having a day with a lower level of behavior problems by the child with ASD was followed by a day with higher positive affect in fathers.

There was a significant within-person interaction of previous-night sleep quality $\times$ level of behavior problems by the child with ASD on level of positive affect for fathers ($\beta = 0.04, p = 0.02$). This interaction occurred at a trend level for mothers ($\beta = 0.02, p = 0.07$). As shown in Figure 1, in contrast to our hypothesis, previous-day level of behavior problems by the child with ASD predicted declines in positive affect following a night with high sleep quality in fathers (1 SD above mean), but was unrelated following a night with low sleep quality (1 SD below mean).

In the model predicting level of negative affect, at a between-person level (Level 2), mothers who had a younger child with ASD ($\beta = -0.24, p = 0.03$) and mothers of children with ASD with a higher mean level of behavior problems (global behavior problems) ($\beta = 0.21, p < 0.001$) reported a higher initial level of negative affect. Fathers who had a child with a higher severity of ASD symptoms ($\beta = 0.02, p = 0.03$), fathers with lower household income ($\beta = -0.18, p = 0.05$), fathers with higher education ($\beta = 0.60, p < 0.01$), and fathers with a lower mean previous-night sleep quality (global sleep quality) ($\beta = 0.98, p < 0.001$) reported a higher initial level of negative affect.

With parent and child socio-demographics at their mean, and controlling for the between-person effects of mean level of behavior problems by the child with ASD and mean previous-night sleep quality, lower previous-night sleep quality predicted a higher level of negative affect at a within-person, day-to-day, level (Level 1) for both mothers ($\beta = 0.50, p < 0.001$) and fathers ($\beta = 0.44, p < 0.001$). In other words, parents reported a lower level of negative affect following a night with high sleep quality. In addition, a lower previous-day level of behavior problems by the child with ASD predicted a lower level of negative affect for both mothers ($\beta = 0.20, p < 0.001$) and fathers ($\beta = 0.26, p < 0.001$).

There was also a significant within-person interaction of previous-night sleep quality $\times$ level of behavior problems by the child with ASD on level of negative affect for fathers ($\beta = 0.03, p < 0.01$). As shown in Figure 2, in contrast to our hypothesis, higher previous-day level of behavior problems by the child with ASD only predicted increases in level of negative affect following a night with high sleep quality (1 SD above mean), but was unrelated following a night with low sleep quality (1 SD below mean).

Discussion

The goal of this study was to understand the impact of parents' sleep quality on their experience of behavior problems by their child with ASD. We found that at a within-person, day-to-day level, fluctuation in previous-night sleep quality was not associated with the level

of behavior problems by the child with ASD for mothers or fathers. However, mothers who had higher global sleep quality reported a lower initial level of behavior problems by the child with ASD. Together, findings suggest that for mothers, persistent sleep difficulties are associated with experiencing a higher level of behavior problems by the child with ASD. However, after taking this into account, a night with poor sleep quality does not further increase mothers' rating of level of behavior problems by the child with ASD. This study cannot tease apart the causal role of these between-person effects, nor can it determine whether differences pertain to subjective experience of or actual level of behavior problems by the child with ASD. Mothers' persistent sleep difficulties may result in perceptions of a higher frequency and severity of behavior problems by the child with ASD (altering *subjective* experience) and/or less effective parenting, subsequently leading to more behavior problems by the child with ASD (altering *objective* levels). Alternatively, higher perceived levels of behavior problems by the child with ASD may contribute to mothers' sleep difficulties, due to parenting stress, mental health symptoms, and/or child sleep problems, which co-occur with behavior problems (Sikora et al., 2012).

It is unclear why sleep quality was not associated with fathers' rating of level of behavior problems by the child with ASD. There is a marked gender division of labor in families of children with ASD (Hartley et al., 2014); one possibility is that fathers' sleep is less associated with child-related stress, given less time spent in child-related activities. Alternatively, fathers may be better able to cope with poor sleep, isolating any impact on parenting experiences. Fathers reported a lower level of global sleep quality than mothers; thus, it is also possible that reduced global sleep quality diminished any between-person and within-person effects of poor sleep quality on parenting experiences.

Previous-night sleep quality had important consequences for daily affect in parents of children with ASD. Across parents (between-parent level), mothers and fathers who had higher global sleep quality had a higher level of positive affect than parents with lower global sleep quality. Fathers with higher global sleep quality also had a lower level of negative affect than fathers with lower global sleep quality. In addition, across days (within-person level), following nights with poor sleep quality, both mothers and fathers reported decreased positive affect and increased negative affect. The magnitude of this effect was moderate to large. Indeed, previous-night sleep quality was more strongly related to day-to-day fluctuations in parents' affect than the perceived behavior problems of the child with ASD.

Although previous-night sleep quality was unrelated to daily fluctuations in parents' rating of the level of behavior problems by child with ASD, it did moderate the association between level of behavior problems by the child with ASD and level of positive and negative affect for fathers. However, this effect was opposite of our hypothesis. Experiencing a day with high behavior problems by the child with ASD only took a toll on fathers' affect if they had high previous-night sleep quality. One interpretation of this pattern is that poor sleep quality has such strong impacts on fathers' affect that child-related stressors exert little influence following a night of disruptive sleep. However, if fathers slept well, then high child-related stressors negatively impacted paternal affect the next day.

This study has several strengths. We used a daily diary to examine day-to-day time-order effects, while examining and controlling for between-person effects. Associations were examined over a lengthy time period. There were also limitations. Our sample consisted largely of White, non-Hispanic parents, reflecting our Midwestern, US location and ASD diagnosis trends (Durkin et al., 2010), but preventing investigations of cultural differences. Additionally, we used a single-item measure of sleep quality, albeit one with strong validity (Cappelleri et al., 2009). Future research should include objective measures of sleep quality, as parents may use different thresholds for judging sleep quality. In addition, this study is unable to disentangle the subjective bias of parents' perceptions from objective differences in level of behavior problems by the child with ASD. Future studies should include an independent measure of child behavior problems, outside of parent-report, such as teacher-report or observational ratings. Finally, future research should determine whether findings apply to other contexts of high child-related stressors (e.g. attention-deficit/hyperactivity disorder) and/or differ in parents of children without disabilities.

In summary, findings highlight that parent circumstances shape the experience of child-related stressors. Parental sleep quality has important between-person and within-person, day-to-day, associations with the experience of behavior problems by the child with ASD. Interventions promoting high parental sleep quality could improve the psychological well-being of parents of children with ASD. In addition, in mothers who have persistently poor sleep, improving sleep quality may lead to the experience of less frequent and severe behavior problems by the child with ASD. Interventions promoting high sleep quality in fathers should be paired with strategies for managing child behavior problems, and/or perceptions about these behaviors, and stress-reduction, given that the behavior problems of children with ASD influence fathers' affect when resources are not depleted from a night of poor sleep quality.

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Figure 1. Moderating effect of previous-night sleep quality on association between daily rating of level of behavior problems by the child with ASD and level of positive affect for fathers. Dashed lines indicate 95% confidence intervals for slopes.

Figure 2. Moderating effect of previous-night sleep quality on the association between daily rating of level of behavior problems by the child with ASD and level of negative affect for fathers. Dashed lines indicate 95% confidence intervals for slopes.

Table 1

Socio-demographic characteristics of families of children with autism spectrum disorder.

Parents (<i>n</i> = 352)	
Mother age in years, <i>M</i> (<i>SD</i>)	38.64 (5.19)
Range	25–54
Father age in years, <i>M</i> (<i>SD</i>)	40.74 (5.83)
Range	24–57
Household income, <i>M</i> (<i>SD</i>)	US\$80,000–US\$89,999 (US\$25,000)
Range	US\$10,000–US\$160,000+
Education, <i>n</i> (%)	
Less than high school	9 (2.6%)
High school degree or GED	25 (7.1%)
Some college	58 (16.5%)
College degree	167 (47.4%)
Some graduate school	22 (6.3%)
Graduate or professional degree	71 (20.2%)
Race/ethnicity, <i>n</i> (%)	
Caucasian, non-Hispanic	316 (89.8%)
Hispanic	22 (6.3%)
African-American	4 (1.1%)
American Indian	1 (0.3%)
Asian or Pacific Islander	9 (2.6%)
Children with ASD (<i>n</i> = 176)	
Age in years, <i>M</i> (<i>SD</i>)	7.93 (2.29)
Range	5–12
Gender, <i>n</i> (%)	
Male	152 (86.4%)
Intellectual disability, <i>n</i> (%)	59 (33.5%)
SRS, <i>M</i> (<i>SD</i>)	77.78 (10.61)
CBCL, <i>M</i> (<i>SD</i>)	65.44 (9.36)
ABAS, <i>M</i> (<i>SD</i>)	65.00 (17.67)

SD: standard deviation; ASD: autism spectrum disorder; GED: General Education Development; SRS: Social Responsiveness Scale Total T-score; CBCL: Child Behavioral Checklist Total T-score; ABAS: Adaptive Behavior Assessment System Standardized General Adaptive Composite score.

Table 2

Multilevel model of previous-night sleep quality predicting behavior problems.

	Mother		Father	
	Unstandardized coefficient (<i>SE</i>)	Effect size (<i>r</i>)	Unstandardized coefficient (<i>SE</i>)	Effect size (<i>r</i>)
Level 1				
Time	−0.07 (0.03) *	0.17	−0.01 (0.02)	0.05
Previous-night sleep quality	0.07 (0.07)	0.07	0.01 (0.05)	0.02
Level 2				
Intercept	6.55 (0.44) ***	0.76	4.32 (0.36) ***	0.69
Child age	−0.26 (0.14) †	0.14	−0.35 (0.12) **	0.23
ID status	1.48 (0.74) *	0.16	0.98 (0.61)	0.12
Severity autism symptoms	0.07 (0.01) ***	0.47	0.06 (0.01) ***	0.42
Household income	−0.02 (0.10)	0.02	−0.05 (0.10)	0.04
Parent education	−0.55 (0.25)	0.14	−0.10 (0.23)	0.04
Mean previous-night sleep quality	0.80 (0.35) *	0.18	0.60 (0.33)	0.14
Random effects (variance estimates)				
Level 2				
Time	0.09 ***		0.01	
Previous-night sleep quality	0.08 *		0.01	

SE: standard error; ID: intellectual disability.

Effect size was calculated with the following equation: $r = \sqrt{\frac{\tau^2}{\tau^2 + df}}$; small effect: $r > 0.10$, medium effect: $r > 0.24$, and large effect: $r > 0.37$ (Kirk, 1996).† $p < 0.07$;* $p < 0.05$;** $p < 0.01$;*** $p < 0.001$.

Table 3

Multilevel models of previous-night sleep quality and behavior problems predicting daily positive and negative affect.

	Positive affect			Negative affect		
	Mother		Father	Mother		Father
	Unstandardized coefficient (SE)	Effect size (<i>r</i>)	Unstandardized coefficient (SE)	Unstandardized coefficient (SE)	Effect size (<i>r</i>)	Unstandardized coefficient (SE)
Level 1						
Time	*** -0.12 (0.03)	0.27	*** -0.14 (0.03)	*** -0.13 (0.03)	0.35	*** -0.12 (0.02)
Previous-night sleep quality	*** -1.09 (0.13)	0.54	*** -1.00 (0.13)	*** 0.50 (0.11)	0.26	*** 0.44 (0.09)
Behavior problems	[†] -0.12 (0.06)	0.15	[†] -0.20 (0.07)	*** 0.20 (0.06)	0.33	*** 0.26 (0.05)
Previous-night sleep quality < behavior problems	[†] 0.02 (0.01)	0.14	[†] 0.04 (0.02)	[†] 0.00 (0.01)	0.01	[†] -0.03 (0.01)
Level 2						
Intercept	*** 27.17 (0.65)	0.96	*** 29.04 (0.71)	*** 15.71 (0.46)	0.94	*** 15.68 (0.43)
Child age	0.23 (0.18)	0.10	[†] 0.48 (0.20)	[†] -0.24 (0.11)	0.17	[†] -0.00 (0.10)
ID status	[†] 1.99 (0.94)	0.16	[†] 0.82 (0.93)	[†] -0.03 (0.47)	0.00	[†] 0.30 (0.50)
ASD symptoms	0.00 (0.02)	0.00	[†] -0.04 (0.02)	0.00 (0.01)	0.01	[†] 0.02 (0.01)
Household income	0.01 (0.15)	0.00	0.19 (0.17)	-0.04 (0.07)	0.05	[†] -0.18 (0.09)
Parent education	0.17 (0.40)	0.03	-0.53 (0.37)	0.14 (0.21)	0.05	[†] 0.60 (0.19)
Mean previous-night sleep quality	[†] -1.32 (0.45)	0.22	[†] -1.37 (0.42)	[†] -0.40 (0.27)	0.12	*** 0.98 (0.25)
Mean behavior problems	-0.16 (0.10)	0.13	0.15 (0.13)	*** 0.21 (0.06)	0.27	[†] 0.15 (0.08)
Random effects (variance estimates)						
Level 2						
Time	*** 0.09		*** 0.08	*** 0.05		*** 0.05
Previous-night sleep quality	0.48		0.62	[†] 0.43		0.29
Behavior problems	[†] 0.13		0.04	[†] 0.09		0.10
Previous-night sleep quality < behavior problems	[†] 0.00		0.00	[†] 0.00		0.00

SE: standard error; ID: intellectual disability; ASD: autism spectrum disorder.

Effect size was calculated with the following equation: $r = \sqrt{\ell^2 / (\ell^2 + d\theta)}$; small effect: $r > 0.10$, medium effect: $r > 0.24$, and large effect: $r > 0.37$ (Kirk, 1996).

[†] $p < 0.07$;

* $p < 0.05$;

.1000 > d

;10.0 > d
**

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