Sleep problems as possible predictors of intensified symptoms of autism[☆]

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Abstract

Researchers have been placing an increased importance on discovering what variables contribute to better prognosis during behavioral interventions for children with autism. This article preliminarily identifies sleep problems that may exacerbate symptoms of autism; thus, possibly influencing effectiveness of daytime interventions. A database of parent report of sleep problems of children with autism ($N = 55$), ranging from 5 to 12 years of age ($M = 8.2$ years) was evaluated. Results suggested that fewer hours of sleep per night predicted overall autism scores and social skills deficits. Similarly, stereotypic behavior was predicted by fewer hours of sleep per night and screaming during the night. Increased sensitivity to environmental stimuli in the bedroom and screaming at night predicted communication problems. Finally, sensitivity to environmental stimuli in the bedroom also predicted fewer developmental sequence disturbances. The results indicate that sleep problems and the diagnostic characteristics of autism may be related. However, future research must be completed to determine the specific relationship.
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Research has continually supported the efficacy of an applied behavior analysis treatment approach for children with autism (see New York State Department of Health Early Intervention Program, 1999). Final outcomes of intensive treatments have suggested that a minority of children with autism ultimately can be placed successfully in typical educational classrooms without needing extraordinary assistance to do their schoolwork (Lovaas, 1987). However, only a few variables, such as Intelligence Quotient before treatment (Lovaas & Smith, 1988; Smith, Eikeseth, Klevstrand, & Lovaas, 1997), younger age at the start of intervention (Fenske, Zalenski, Krantz, & McClannahan, 1985; Lovaas, 1987), and initial treatment learning rates (Lovaas, 1987; Weiss, 1999) have even been tentatively identified as predictors of success with this behavioral intervention approach. Since this treatment has been acknowledged as labor, time, and cost intensive, more research must be done to help identify possible predictors and obstacles to treatment success.

Sleep problems have been consistently identified to negatively influence learning rate and cognitive performance in typically developing youngsters and adults. Sleep deprivation has been shown to impair cognitive, verbal, motor, visuo-spatial and creative performance (Horne, 1988; Pilcher & Huffcutt, 1996; Randazzo, Muehlbach, Schweitzer, & Walsh, 1998; Stores, 1999), to alter emotional state (Bonnet, 1994; Pilcher & Huffcutt, 1996; Stores, 1999), and to impair flexibility to change (Horne, 1988; Randazzo et al., 1998). Additionally, sleep problems have been implicated in behaviors that interfere with learning, such as general behavior problems (Guilleminault, Winkle, Korobkin, & Simmons, 1982; Stores, 1999), non-compliance (Pritchard & Appleton, 1988), inattention to task (Stores, 1999), irritability (Bonnet, 1994), depression (Bonnet, 1994), hyperactivity (Guilleminault et al., 1982), and aggression (Guilleminault et al., 1982).

Despite the research relating sleep deprivation to learning difficulties and inappropriate day behavior, the influence of sleep problems for children with autism has been neglected. The limited research available suggests a few general relationships between sleeping problems for children with autism and their daytime behavior including increased rates of overactivity (Hoshino, Watanabe, Yashima, Kaneko, & Kumashiro, 1984), disruptive behavior (Patzold, Richdale, & Tonge, 1998), communication difficulties (Segawa, Katoh, Katoh, & Nomura, 1992), social difficulties (Segawa et al., 1992), and difficulties with breaking routines (Segawa et al., 1992) which are all problems that could significantly interfere with daytime learning.

The foregoing relationships among sleep problems for children with autism and daytime inappropriate behavior suggest that additional research is required to delineate direct connections among the specific sleep problems and the specific day time behavior patterns that may affect children with autism's behaviors, and thereby, possibly, treatment success. No previous studies have directly assessed how the fundamental diagnostic characteristics of autism could themselves be exacerbated by sleep problems. The current study was designed to provide a preliminary examination of the hypothesis that specific sleep problems may be related to the expression of cardinal behavioral features of autism.

1. Method

1.1. Participants

Data were accessed from a database established for previous research on types of sleep problems for children with autism (Schreck & Mulick, 2000). In the study that established the database, parents ($N = 55$) were recruited from members of autism advocacy groups, newsletter and international computer bulletin boards, parents of children enrolled in Ohio county boards of Mental Retardation and Developmental Disabilities classes, and parents of children in special education classrooms in urban and rural public schools in North-Central Ohio. Data included responses from parents of children between the ages of 5–12 years ($M = 8.2$, SD $= 2.1$).

To be classified in this study with an Autistic Disorder or Pervasive Developmental Disorder required (a) an affirmative parental response to an item asking if the child was diagnosed with an autism spectrum disorder and (b) a Gilliam Autism Rating Scale (GARS: Gilliam, 1995) score indicating a good probability that autism was an accurate diagnosis (GARS Autism Quotient ≥ 80). Schreck and Mulick (2000) indicated there were no significant differences in demographics or sleep problems between the children with GARS scores ≥ 80 and reported autism ($n = 38$) and children with GARS scores ≥ 80 and no reported autism ($n = 17$), therefore data from both groups of children were combined in the present study.

1.2. Materials

Data base information consisted of responses to three forms: a self-report demographic form, the GARS, and the Behavior Evaluation of Disorders of Sleep ([BEDS] Schreck, 1997/1998; Schreck & Mulick, 2000; Schreck et al., 2003).

1.3. Demographic questionnaire

The demographic information included parental information (survey reporter, marital status, race, work shifts, diagnosed sleep disorders, and residence location), and child statistics (sex, age, developmental diagnoses, professionally diagnosed sleep disorders, current medications, location of sleeping arrangements, and educational placement) (Schreck & Mulick, 2000 for specific demographic information).

1.4. The BEDS

The BEDS (Schreck, 1997/1998; Schreck et al., 2003) is a sleep problem questionnaire constructed from items from the International Classification of Sleep Disorders (ICSD: American Sleep Disorders Association, 1991) categorization of the Dyssomnias and Parasomnias, was developed for children aged

5–12 years. The original BEDS included 107 items measuring sleep behaviors based and sleep disorders related to children. Responses to the items were on a 5-point Likert scale (0 = never; 1 = almost never; 2 = sometimes; 3 = almost always; 4 = always). More general aspects of children's sleep, such as hours slept per night, hours slept in last 24 hr, hours napping, and parents' perception of a sleep problem were added to the end of BEDS questionnaire. Parents' answers reflected their child's sleep behavior for the last 6 months.

Factor analyses from the original norming ($N = 307$) and confirmatory factor analysis ($N = 1054$) samples of the 107 Likert type statements resulted in a 22 item, four factor scale (Expressive Sleep Disturbances [9 items], Sensitivity to the Environment [7 items], Disoriented Awakenings [4 items], and Apnea [2 items]). This scale distinguished between children with a sleeping problem and those without. The four factors exhibited adequate internal consistency (BEDS total score $\alpha = .82$; Expressive Sleep Disturbances $\alpha = .85$; Sensitivity to the Environment $\alpha = .65$; Disoriented Awakening $\alpha = .79$; Apnea $\alpha = .60$); ability to discriminate between those with sleep problems and those without (Mann–Whitney U ranges = 7995.5 to 14445.5, $p < .001$); and correlations between professionally diagnosed sleep disorders and reports of sleep problems (Factor 1: $r_s(1028) = .22$, $p < .01$; Factor 2: $r_s(1028) = .19$, $p < .01$; Factor 3: $r_s(1028) = .16$, $p < .01$; Factor 5: $r_s(1026) = .14$, $p < .01$).

1.5. The Gilliam Autism Rating Scale

The diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders: Fourth Edition (DSM-IV; American Psychiatric Association, 1994) and from the Autism Society of America (1994) comprise the four domains of the Gilliam Autism Rating Scale (Gilliam, 1995). The scale provides measurements of Stereotyped Behavior, Communication, Social Interaction, and Developmental Disturbances, which yield an overall Autism Quotient (AQ). Standard scores in the manual were derived from a sample of children with autism ($N = 1092$). Adequate reliability and validity of an autism diagnosis exist for the Autism Quotient for scores ≥ 80. The test manual reported adequate validity and reliability for test domains and the Autism Quotient (Gilliam, 1995).

1.6. Data analysis

Data were analyzed from the database compiled for Schreck (1997/1998) and for Schreck and Mulick (2000). In constructing the database, parents' responses were recorded for a demographic questionnaire, the BEDS, and the GARS. Schreck and Mulick (2000) contains specific procedures for obtaining the information collected for the database. In brief, these procedures involved randomized sampling of parents of typically developing children within school district classrooms, as well as sampling of the participant sample described within this study.

All analyses were computed using the Statistical Package for the Social Sciences (SPSS, 1995, 2000). Before analyzing the relationships among sleep

Table 1
Descriptive statistics for BEDS and GARS factors

Factors	N	Mean	SD
GARS			
Autism Quotient	53	93.55	12.61
Stereotypy	53	9.40	3.00
Communication	49	10.10	2.74
Social	53	8.72	3.10
Developmental	53	8.19	2.56
BEDS			
Hours per night	55	9.17	1.46
Hours of naps	54	0.34	0.82
Expressive Awakening	55	3.49	5.62
Environmental	55	5.34	4.56
Disoriented Awakening	55	4.75	3.73
Apnea	54	0.44	1.38

problems and the diagnostic criteria for autism, Pearson correlations analyses were conducted to determine if the BEDS items measuring amounts of sleep (i.e., sleep in the last 24 hr, hours slept per night, and hours napping), the BEDS Factors, and the GARS Domains were related. This analysis indicated that the BEDS Factor #3—Disoriented Awakening and the BEDS item—hours of naps per day did not significantly relate to the other variables (see Table 1 for Descriptive Statistics and Table 2 for the Bivariate Relationships among the variables). Consequently, these variables were eliminated from further analyses. As Table 2 indicates, all of the remaining BEDS items and GARS Domains were significantly related, and thus, were included in the subsequent analyses of which sleep problems predicted which of the daytime behavior problems.

Stepwise multiple linear regression analyses were conducted to determine if the remaining BEDS Factors (i.e., Expressive Awakening, Environmental Factors, Apnea) and the BEDS item, hours of sleep per night, predicted the specific GARS Domains (i.e., Communication, Stereotypy, Social Skills, and Autism Quotient). These analyses were conducted separately for each of the GARS diagnostic domains. The results of the analyses are presented in Table 3.

2. Results

The first stepwise multiple regression analysis was conducted to determine if the BEDS Factors and the sleep per night item predicted the GARS Communication score. This analysis revealed communication problems (GARS Communication subscale) were significantly related to increased sensitivity to stimuli in the sleeping environment (BEDS Factor 2: Sensitivity to the Environment) and by periods of screaming during the night (BEDS Factor 1: Expressive Awakening) ($R^2 = .18$; $p < .01$). In other words, children with strong responses to the

Table 2
Bivariate correlations for BEDS and GARS factors

Factors	GARS							BEDS			
	Ster	Comm	Social	Dev	AQ	Night	Naps	#1	#2	#3	#5
Stereotypy (Ster)	1.00	.52**	.72**	−.01	.86**	.35**	.19	.34**	.11	.08	.17
Communication (Comm)		1.00*	.57**	−.31*	.68**	−.14	.17	.33*	.33*	.06	−.17
Social			1.00	−.06	.85**	−.34*	.04	.25*	.29	.01	.24
Developmental (Dev)				1.00	.19	−.09	.06	−.28*	.34*	−.08	.22
Autism Quotient (AQ)					1.00	−.33**	.11	.22	.15	.02	.19
Hours per night (night)						1.00	.05	−.25	−.21	−.22	−.33*
Hours of naps (naps)							1.00	.04	−.12	.02	−.12
Expressive Awakening (#1)								1.00	.17	.06	.10
Environmental (#2)									1.00	.26	−.19
Disoriented Awakening (#3)										1.00	.03
Apnea (#5)[a]											1.00

[a] Factor #5 was retained for Apnea for consistency with Schreck (1997/1998) and Schreck et al. (2003).
* $p < .05$.
** $p < .01$.

Table 3
Stepwise multiple regression predicting diagnostic autism behavior

GARS Domains	
Communication	
F	5.12[**]
R^2	.18
Predictors	(1) Sensitivity to the environment
	(2) Expressive Awakening
Developmental	
F	6.28[*]
R^2	.11
Predictors	(1) Sensitivity to the environment
Stereotypic	
F	5.88[**]
R^2	.19
Predictors	(1) Hours slept per night
	(2) Expressive Awakening
Social skills	
F	6.55[**]
R^2	.12
Predictors	(1) Hours slept per night
Autism Quotient	
F	6.12[*]
R^2	.11
Predictors	(1) Hour slept per night

[*] $p < .05$.
[**] $p < .01$.

environment at night and who tend to awaken at night show more markedly autistic-type communication patterns on the GARS.

Sensitivity to environmental stimuli and screaming during the night were also related to other worsening of diagnostic characteristics of autism. Sensitivity to the environment (BEDS Factor 2) was found to be a significant predictor of fewer disturbances during development (GARS Developmental domain) ($R^2 = .11$, $p < .02$). Screaming during the night (BEDS Factor 1: Expressive Awakening) in combination with fewer hours of sleep per night also predicted increased stereotypic behavior ($R^2 = .19$, $p < .01$). Fewer number of hours slept per night also predicted difficulties with social interactions (GARS Social Skills) ($R^2 = .12$) and overall diagnostic characteristics of autism (GARS Overall Autism Quotient)($R^2 = .11$, $p < .02$).

3. Discussion

Wiggs and Stores (1996) asserted that it is difficult to determine if the sleep problems of children with daytime behavioral difficulties cause the behavior

problems, maintain existing problems, or exacerbate problems already present. Although this study does not answer this poignant question, it continues to provide support that sleep problems and day behavior are directly connected. In fact, this study indicated that sleep problems predicted more intense symptoms of autism. This is not surprising but it is consistent with clinical experience and with commonsense expectations; disturbed sleep at night has persistent consequences during the day (e.g., Guilleminault et al., 1982; O'Reilly & Lancioni, 2000; Wiggs & Stores, 1999).

Because only a relatively small amount of the variance in the daytime symptoms of autism was explained by the children's sleep problems, questions are created concerning the role of sleep problems in determining day time behavior of children with autism. It is possible that neurotransmitter abnormalities (e.g., serotonin) or the autism characteristics themselves exacerbate sleep problems. However, at this time, a research base examining the relationship of sleep problems and the diagnostic criteria for autism, including support for the strength of this relationship and other possible predictors, has not been established. Since this research base does not exist, this study provides preliminary data concerning these relationships to clinicians and researchers.

In this study, the sleep problem best predicting the GARS Autism Quotient, or overall diagnostic characteristics of autism, was the reported amount of hours per night the child slept. The fewer hours slept—the more severe the reported symptoms of autism. The fewer hours the child reportedly slept per night also partially predicted the severity of stereotypic behaviors and the difficulties with socially relating to other people in the environment. This could have implications for the child's response to educational and habilitative activities during the day if the relationship holds up in future studies. Children who are more inwardly focused during the day may more actively resist participation in functional and social learning opportunities.

In addition to the quantity of time slept, the quality of sleep for children with autism also predicted the severity of daytime behaviors related to autism. Children who awakened screaming were more likely to experience higher rates of stereotypy and to have more communication abnormalities. Children who reacted to uncomfortable sleeping environments (noise, light, etc.) were also more likely to have communication problems and to have more general abnormalities in development that are commonly related to autism (e.g., rocking, regression in skills, delays in speech development, etc.).

In conclusion, while previous evidence existed that sleep problems and sleep deprivation impaired general learning (Horne, 1988; Pilcher & Huffcutt, 1996; Randazzo et al., 1998; Stores, 1999) and behavior (Bonnet, 1994; Guilleminault et al., 1982; Horne, 1988; Pilcher & Huffcutt, 1996; Pritchard & Appleton, 1988; Randazzo et al., 1998; Stores, 1999) in typically developing populations, before this study only two previous studies examined the specific relationship of symptomatic behavior to sleep in autism (Hoshino et al., 1984; Segawa et al., 1992). Other research with sleep and daytime behavior problems in general populations would suggest that treatments of children's sleep problems (Sanders,

Bor, & Dadds, 1984) and in people with mental retardation (Durand, Gernert-Dott, & Mapstone, 1996; O'Reilly, 1995; Thackeray, 2000; Wiggs & Stores, 1999) have resulted in decreases in inappropriate day behavior. It is certainly plausible that the same would be true with respect to children with autism and perhaps, as this study implies, with the severity of the expression of their symptomatic behavior.

Acknowledgments

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