Behavioral Interventions for Sleep Problems in Children With Autism Spectrum Disorders: Current Findings and Future Directions

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Objective  To examine behavioral interventions for sleep problems in children with autism spectrum disorders (ASD).  Methods  A systematic review evaluating all published studies examining the effectiveness of behavioral treatment of sleep problems in children with ASD is presented.  Results  Based on the Chambless criteria for treatment efficacy, both standard extinction and scheduled awakenings met criteria for possibly efficacious interventions for sleep problems in children with ASD. Some positive outcomes have been reported, but there has not been enough research examining graduated extinction, faded bedtime, stimulus fading and chronotherapy to make any firm conclusions regarding treatment efficacy for children with ASD.  Conclusions  Although more rigorous research is required in order for any sleep interventions for children with ASD to be considered probably efficacious or well-established, the current literature should be used to guide clinical decisions and direct research questions.

Key words  autism spectrum disorders; behavioral interventions; intervention outcome; sleep; systematic review.

Introduction

Autism spectrum disorders1 (ASDs) are a set of neurodevelopmental disorders that are characterized by social, communication, and behavioral impairments. Recent studies suggest prevalence rates for ASD to be 60–70 cases per 10,000 individuals (Fombonne, 2009). Prevalence estimates of sleep problems in children with ASD range from 44% to 83% (Patzold, Richdale, & Tonge, 1998; Richdale & Prior, 1995). Although the high rates of sleep problems suggest a need for empirically supported interventions, there is little published literature examining the treatment of sleep problems in children with ASD.

1In this article, ASD encompasses diagnoses of autism spectrum disorders, autism, Asperger’s Disorder, or pervasive developmental disorder (PDD), not otherwise specified. For accuracy, autism, Asperger’s Disorder, or PDD have been used in the text if authors specifically used these terms to describe their sample.

Presentation of Sleep Problems in Children With ASD

Sleep problems in children with ASD have been well documented in studies using parental report. The most commonly reported are problems with sleep onset and maintenance, including long sleep onset latencies, night waking, short night sleep duration, and early morning waking (Krakowiak, Goodlin-Jones, Hertz-Picciotto, Croen, & Hansen, 2008; Richdale & Prior, 1993). However, few studies have employed objective measures such as polysomnography (PSG) and actigraphy. PSG is the measurement of sleep using physiological variables such as brain waves and eye movements. Actigraphy is an indirect measure of sleep using an actigraph (a device resembling a wristwatch) that records activity patterns and can estimate sleep parameters.

Much of the research using objective measures corroborates parent-reported sleep problems in children with ASD. This research has revealed that children with...
ASD, compared to typically developing (TD) children, have increased sleep onset latency (Allik, Larsson, & Smedje, 2006; Malow et al., 2006), decreased sleep efficiency (Diomedi et al., 1999; Malow et al., 2006; Wiggs & Stores, 2004), an increased number of night wakings and longer night wakings (Diomedi et al., 1999; Wiggs & Stores, 2004), as well as more variable sleep times (Wiggs & Stores, 2004). In addition, PSG studies suggest that individuals with ASD are more likely to experience disrupted rapid eye movement (REM) sleep (Diomedi et al., 1999; Godbout, Bergeron, Limoges, Stip, & Mottron, 2000).

Although objective measures frequently reveal differences in sleep in children with ASD compared to TD children, a few studies suggest that objective and subjective measures do not always coincide. Some researchers have found that parents of children with ASD over-report sleep problems, compared to parents of TD children (Goodlin-Jones et al., 2009). Others have found that actigraphy supports only some parent-reported sleep problems (Hering, Epstein, Elroy, Iancu, & Zelnick, 1999). These discrepancies may result from various factors including varied methodologies, difficulties with participant compliance, small sample sizes, and the complexity of ASD (i.e., diverse symptom expression, comorbid symptoms or disorders).

Consequences of Sleep Problems in Children With ASD

Children with sleep problems (both those with and without ASD) show more challenging behaviors than children without sleep problems (Allik et al., 2006; Sadeh, 2007). It is likely that sleep problems maintain and exacerbate daytime behavior problems in children with ASD. Children with ASD and sleep problems tend to have more severe autism symptoms such as stereotypic behaviors, social difficulties, and emotional symptoms, as well as more behavior problems than those who do not have sleep problems (Allik et al., 2006; Malow et al., 2006; Patzold et al., 1998; Schreck, Mulick, & Smith, 2004). In addition, a number of studies have demonstrated that parents of children with ASD experience increased levels of stress relative to parents of children with other disabilities (e.g., Eisenhower, Baker, & Blacher, 2005), and that this is more so in parents of children with ASD and sleep problems (Hoffman et al., 2008). Given these associations between inadequate sleep, intensified daytime behavior problems, and parental stress, there is a strong need to develop effective sleep intervention programs for this population.

Behavioral Treatments and Interventions

Behavioral interventions are highly effective in treating sleep problems in TD children, particularly problems initiating and maintaining sleep (e.g., Mindell, Kuhn, Lewin, Meltzer, & Sadeh, 2006). The behavioral problems of children with ASD are also amenable to intervention with behavioral methods (Hall, 1997), and their sleep problems appear to be similarly treatable. Behavioral interventions for sleep problems have a number of advantages over pharmacological approaches. Parents of children with ASD prefer behavioral approaches over sleep-enhancing medications (Williams et al., 2006). In addition to the direct impact of behavioral interventions on the child, these interventions have also been shown to increase parents’ sense of competence, control, and ability to cope (Woolson, Lacks, & Futterman, 1992). Despite these advantages, behavioral interventions are not offered to families of children with ASD as frequently as pharmacological treatments (Gail, Sears, & Allard, 2004). Unfortunately, systematic, controlled studies evaluating the efficacy of behavioral interventions for sleep problems are lacking for children with ASD.

A decade has passed since the last published review of behavioral interventions for sleep problems in children with ASD (Schreck, 2001). A comprehensive literature search conducted through February 2011 revealed 15 published studies that examined behavioral interventions for sleep problems in children with ASD (Table I for a summary), indicating that the number of studies in this area has more than doubled since the last review. This article offers an updated systematic review of behavioral treatment of sleep problems in this population with the aim of describing and evaluating the current literature and suggesting directions.

Methods

Consistent with the review by Schreck (2001), we evaluate the efficacy of interventions for sleep problems in children with ASD using criteria established by Chambless and Hollon (1998). Chambless and Hollon described three categories of treatment efficacy: well established, probably efficacious, and possibly efficacious. To be classified as a well-established or probably efficacious treatment, multiple studies must compare the treatment to another treatment or a wait-list control. In areas of research with a relatively small number of studies, it is unlikely that interventions will meet criteria to be considered well-established or probably efficacious. In fact, in the present review, no interventions reviewed met these criteria. However, the
| Study | Participants/age diagnosis | Sleep problems | Behavioral intervention | Additional information | Findings (postintervention) |
|-------|-----------------------------|----------------|------------------------|-----------------------|-----------------------------|
| Wolf et al., 1964 | One male with autism aged 3.5 years | Night waking involving violent tantrums | Bedtime routine | Conducted in inpatient unit, gradually moved home | Initial increase in problematic behavior By 6th night, child remained in bed; “bedtime problems were seldom an issue again” |
| Howlin, 1984 | One male with autism aged 5.5 years | Initiating sleep, night waking every night, cosleeping | Stimulus fading Parent education | 2-month duration Conducted in home | Child settled within a few minutes, no efforts to return to parents’ bed, decrease in night waking Improvements in mother’s mental health and parents’ marital relationship |
| Durand et al., 1996 | Two children (one male, one female) with ASD (PDD and autism) aged 2 and 12 years (+2 children with other diagnoses) | Frequent bedtime disturbances and difficulties initiating sleep | Graduated extinction Sleep hygiene (bedtime routine) | Intervention duration: 21 weeks (child with PDD); 40 weeks (child with autism) | Reduction in bedtime disturbances in both children; reduction in sleep onset latency in one child |
| Piazza et al., 1997 | Five children with ASD (four with autism, one with PDD) aged 3–8 years (+9 other children with severe behavioral problems) | Early awakenings, difficulties initiating sleep, night waking | Children randomly assigned to faded bedtime with response cost (FBRC; n = 7; three with ASD) OR bedtime scheduling group (n = 7; two with ASD) | Conducted in inpatient unit | FBRC treatment resulted in significantly greater reduction in disturbed sleep than bedtime scheduling for entire sample Heterogeneous sample, no specific conclusions about ASD Individual data: three children with ASD in FBRC group; all improved. Of two children with ASD in bedtime scheduling group, one showed slight improvements; other showed no change in sleep |
| Piazza et al., 1998 | One female with autism, severe developmental delay, congenital omphalocele, and food refusal, aged 8 years | Disrupted sleep-wake schedule | Chronotherapy | Conducted in inpatient unit | Decrease in sleep latency and night waking, increase in total sleep time Gains maintained at 4-month follow-up |
| Weiskop et al., 2001 | One male with autism, aged 4.5 years | Self-settling, cosleeping, night waking | Extinction Bedtime routines Visual supports Sticker charts Parent education (learning principles, giving instruction, partner support) | 3 weekly parent training sessions; review session 5 weeks later | Self-settling, cosleeping and night waking improved Positive changes did not occur until extinction introduced Improvements maintained at 3- and 12-month follow-up Parents no longer considered child to have sleep problem at end of intervention |
| Durand, 2002 | Three children (two male, one female) with autism aged 3, 5, and 7.5 years | Night terrors | Scheduled awakening Parent education | Intervention described to parents in 60–90 min session with therapist | Reduced frequency of night terrors in all three children Total sleep time increased in 2/3 children Parents were satisfied with results |

(continued)
| Study                          | Participants/age diagnosis                                                                 | Sleep problems                                      | Behavioral intervention                                                                 | Findings (postintervention)                                                                                                                                 |
|-------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Christodulu & Durand, 2004    | One male with autism aged 4 years (±3 children with other developmental disabilities)        |          | Sleep restriction, bedtime routines                                                      | Number and duration of bedtime disturbances decreased. Parent satisfaction with child’s sleep increased. Parents reported intervention was easy and practical. |
| Durand & Christodulu, 2004    | One female with autism aged 4 years (±1 child with developmental delay)                      |          | Sleep restriction, bedtime routines                                                      | Number and duration of night wakings decreased. Parent satisfaction with child’s sleep increased. Implementation of sleep restriction program allowed parents to discontinue melatonin without bedtime disturbances. |
| DeLeon, et al., 2004          | One male with autism, severe learning disabilities, and receptive language delay, aged 4 years |          | Graduated extinction, social story, reinforcement chart, tokens, treats                   | Improvement maintained at 6-month follow-up. Rate of post-waking SIB decreased. Frequency of SIB per night waking decreased. Following 1st day, child gradually accepted change and only slept in father’s bed more during the night. |
| Moore, 2004                   | One male with AS, severe learning disabilities, and receptive language delay, aged 4 years   |          | Sleep restriction, bedtime routines                                                      | Improvement maintained at 6-month follow-up. Reduction in night wakings. Rate of post-waking SIB decreased. Persistence of SIB = few occurrences, typically <5min. |
| Montgomery et al., 2004       | 21 children with autism, aged 2–8 years (±4 children with severe learning disabilities)     |          | Parent education, various sleep hygiene components                                          | Randomized controlled trial with a wait-list group. Booklet delivered and behavioral treatment for sleep problems per child-faceto-face. Parents reported improvements maintained at 6-month follow-up. |

(continued)
| Study            | Participants/age diagnosis                                                                 | Sleep problems                                    | Behavioral intervention                                                                 | Additional information                                                                 | Findings (postintervention)                                                                 |
|-----------------|-------------------------------------------------------------------------------------------|---------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Weiskop et al., 2005 (Note: the data from Weiskop et al. 2001 were included in this study) | Six children with ASD (five with autism; one with Asperger syndrome) aged 3.5–7 years (+7 other children with fragile X syndrome) | Bedtime disturbances, cosleeping, night waking | Extinction | 3 weekly parent-training sessions (modeling, role playing, discussion, written information, checklists) | Bedtime disturbances, night waking and cosleeping reduced, insufficient evidence to support change in sleep duration or latency. One child with Asperger syndrome and two children with fragile X were not included in the analyses |
| Reed et al., 2009 | 20 children with ASD (15 with autism; 5 in the ASD range) aged 3–10 years                | Difficulty falling asleep (75%)                   | Extinction Graduated extinction Stimulus fading Sleep hygiene (effective daytime and night-time habits, bedtime routines, optimizing parental interaction at bedtime) Visual supports Reward program | Small group parent education workshops: 3 2-hr sessions conducted over consecutive weeks | Improvements in total and several insomnia-related subscale scores of Children’s Sleep Habits Questionnaire. Night wakings subscale did not improve. Actigraphy showed reduced sleep latency in children presenting with sleep onset delay. Improvements noted in measures of sleep habits and daytime behavior (hyperactivity, self-stimulatory behavior, and restricted behaviors) |
| Moon et al., 2010 | Three children with ASD (one female, two males), IQs in average range, aged 8–9 years     | Significant difficulties initiating sleep          | Faded bedtime with response cost and a reward program were the main strategies Education on sleep physiology and sleep hygiene | Manualized behavioral intervention and weekly phone contact 7–9 week intervention | Reduction in sleep onset latency for all three children. Improvements maintained at 12-week follow-up. All three children showed small decreases in daytime behavior problems. Parents satisfied with the intervention |
interventions will be evaluated as to whether or not they can be considered possibly efficacious.

Chambless and Hollon state that a treatment may be possibly efficacious pending replication “if it has proved beneficial to at least 3 participants in research by a single group” (p. 13) and there is no conflicting evidence. In addition, all categories require studies that are methodologically rigorous, replicable, and have an adequate number and description of participants. Having an adequate number of participants is quantifiable. However, the other requirements are more challenging to assess, particularly what qualifies as ‘methodologically rigorous.’ Chambless and Hollon emphasize the importance of controlling for “expectancy, attention, and the like” (p. 12). For this review, our interpretation of “methodological rigor” required that studies included a means of controlling for non-treatment-related effects (e.g., multiple baseline design, A–B–A–B design, control-group design) to increase confidence that the effects are due to the treatment and not the consequences of receiving attention or due to the expectation of change.

Studies were identified using PsycINFO and PubMed databases using the following key words: (a) autism, autism spectrum, pervasive developmental disorder, neurodevelopmental disorder, mental retardation, and learning disorder; (b) sleep problem, sleep disorder, sleep disturbance, sleep disruption, sleeplessness, insomnia, dyssomnia, night awakenings, night waking, bedtime problems, bedtime resistance, and bedtime refusal; (c) treatment, intervention, management, nonpharmacological and parent training; (d) children, toddler, preschool, and pediatric. Additional articles were sought by hand searching journals and reference lists. Articles were included in this review if they were written in English and reported the efficacy of any behavioral intervention for sleep problems in children with ASD.

**Results**

Based on these criteria, 15 studies were found that involve a combination of sleep hygiene and at least one other behavioral intervention. The interventions are categorized under the following headings: establishing good sleep hygiene/parent education (all 15 studies), standard extinction (3 studies), graduated extinction (2 studies), scheduled awakenings (1 study), faded bedtime/sleep restriction (5 studies), stimulus fading (1 study), chronotherapy (1 study), and multi-component (2 studies). Below we describe each behavioral sleep intervention, review the relevant published literature, and evaluate treatment efficacy.

**Sleep Hygiene**

If poor sleep habits, bedtime routines, and night interactions are not recognized and addressed, other sleep interventions are unlikely to be successful (Johnson, Giannotti, & Cortesi, 2009). Thus, improving sleep habits should always be the first line of treatment (Jan et al., 2008). Most behavioral interventions involve components of improving sleep hygiene such as implementing a bedtime routine and a consistent sleep schedule, ensuring the child’s room is dark and quiet, and avoiding stimulating activities prior to bedtime. Since parents are involved in setting limits around children’s sleep and sleep habits, parent education is crucial. For children with ASD, sleep hygiene practices may need to be adapted to fit the unique needs of the child and family (Jan et al., 2008). For example, children with ASD typically respond well to routines but some become overly fixated on details of routines. Kodak and Piazza (2008) suggest introducing small variations into elements of the bedtime routine (e.g., have the child wear different pajamas) to prevent the routine from becoming an unbreakable ritual.

Only two studies evaluated the effectiveness of sleep hygiene separately from other sleep intervention strategies. In one study (Piazza, Fisher, & Sherer, 1997), sleep hygiene alone slightly improved sleep problems in one child with ASD; however, the other participant showed no improvements. Furthermore, Weiskop, Richdale, and Matthews (2003) implemented a sleep hygiene intervention prior to implementing a standard extinction intervention, and found that positive improvements in sleep were a result of introducing the extinction component rather than the sleep hygiene component. Both of these studies are described in more detail below. Although sleep hygiene alone does not appear to be sufficient to eliminate sleep problems in children with ASD, sleep hygiene is routinely included as a component of more intensive behavioral sleep interventions and is considered a necessary, but not sufficient, component of all sleep interventions.

**Extinction**

Standard extinction involves parents ignoring all bedtime disruptions (i.e., the parent puts the child to bed and there is no interaction until morning). This procedure may result in a temporary increase in negative behaviors (i.e., an extinction burst), which can cause a great deal of distress for the child and parents and may be particularly problematic in children with self-injurious behavior (SIB). For this reason, researchers recommend educating parents about
extinction bursts and providing support during the implement-
ation of such an intervention to help increase parental compliance and thereby the likelihood of improvements. Some researchers/clinicians have implemented a modified version of extinction, graduated extinction. Ferber (1985) was one of the first to outline this procedure, which entails parents ignoring disruptive bedtime behaviors (e.g., crying out) for a predetermined period. At the end of that time, if the child is still engaging in disruptive behaviors, the parent settles the child back in bed. Throughout, the parent is instructed to minimize interaction with the child.

Of the 15 reviewed studies, seven included extinction as an intervention component. However, two studies (Montgomery, Stores, & Wiggs, 2004; Reed et al., 2009) included a variety of interventions without looking at the specific effects of extinction so these studies are described separately. Of the remaining five studies, three examined standard extinction (Weiskop et al., 2005; Weiskop, Matthews, & Richdale, 2001; Wolf, Risley, & Mees, 1964) and two examined graduated extinction (Durand, Gernert-Dott, & Mapstone, 1996; Moore, 2004).

**Standard Extinction**

In examining the effects of standard extinction, Wolf et al. (1964) and Weiskop et al. (2001) conducted single-case studies of children with ASD, whereas Weiskop et al. (2003) analyzed data from five children with ASD (and five children with fragile X syndrome without ASD). Of note, the Weiskop et al. (2005) sample included data from the participant in the Weiskop et al. (2001) case study. In both of the Weiskop et al. studies and the Wolf et al. study, participants were between 3- and 7-years old, and had problems with night wakings. The child in one single-case study had “violent tantrums” associated with his night wakings (Wolf et al., 1964), whereas the children in the Weiskop et al. studies had bedtime disturbances and cosleeping, in addition to night wakings. The Wolf et al. study was conducted in an in-patient unit, whereas the interventions outlined by Weiskop et al. were conducted by parents in their homes. In all three studies, improvements in night wakings were maintained at either 6-month (Wolf et al., 1964) or 12-month (Weiskop et al., 2001; Weiskop et al., 2005) follow-ups. In the Weiskop et al. (2001) case, self-settling and cosleeping also improved. Of note, the Weiskop et al. studies initially introduced various additional components (e.g., sticker charts, visual representation of bedtime routines, partner support strategies), but positive changes in sleep did not occur until the introduction of extinction. These results show that standard extinction decreased night wakings in children with ASD.

Standard extinction meets criteria for a possibly efficacious intervention because it improved sleep problems in at least three participants in a methodologically sound study without conflicting evidence. Weiskop et al. (2005), using a concurrent multiple-baseline design, found that the intervention resulted in improvement in five children (a sixth participant withdrew due to illness). The sample in this study was well described (age, adaptive level, absence of medication, etc.) and the intervention is replicable (sessions are well described, including modifications for specific situations). An additional strength of this study was that extinction followed a short period of a sleep hygiene intervention, and improvements did not occur until extinction was introduced. The Wolf et al. study provides additional support for standard extinction, with a total of six children showing improvements following standard extinction.

**Graduated Extinction**

The two studies examining graduated extinction included one (Moore, 2004) and two (Durand et al., 1996) participants with ASD. All three children experienced problems initiating sleep and were between 2- and 12-years old. Results suggest that graduated extinction reduced sleep onset latency. In addition, in these studies graduated extinction reduced cosleeping (Moore, 2004) and bedtime disturbances (Durand et al., 1996). Although three individuals had improvements in sleep problems following graduated extinction, both of these studies compared post-treatment behavior to pretreatment behavior, with no additional means to control for expectancy effects, attention, or such confounding factors. At this point, although promising positive outcomes have been reported, more methodologically rigorous research examining the effectiveness of graduated extinction is required for it to be labeled possibly efficacious.

**Scheduled Awakenings**

Scheduled awakenings have been effective in treating TD children who experience night terrors (Durand & Mindell, 1999). Night terrors are characterized by a sudden arousal from slow wave sleep, accompanied by signs of intense fear, such as screaming or crying. Only one study examined the effectiveness of scheduled awakenings as an intervention for sleep problems in children with ASD (Durand, 2002). This study examined treatment of night terrors in three 3-to-7-year-olds with autism. Durand used scheduled awakenings of the children ~30 min prior to an expected sleep terror episode. Scheduled awakenings reduced night terrors and increased total sleep time,
suggested that appropriately timed awakening may be an effective approach to treating chronic sleep terrors in this population. Although only one study has examined the effectiveness of scheduled awakenings in children with ASD, it meets the requirements to support this intervention being classified as possibly efficacious. Durand (2002) used a multiple baseline design to demonstrate a reduction in the frequency of night terrors in all three individuals following a scheduled awakenings intervention. The sample was well described and enough detail was provided to replicate this intervention.

**Faded Bedtime/Faded Bedtime With Response Cost (FBRC)/Sleep Restriction**

Faded bedtime involves first determining a time at which it is likely that the child will fall asleep within 15 min of going to bed. Once the child falls asleep at this time with little resistance, the bedtime is set earlier and earlier each night until the desired bedtime is achieved. In addition, the child is awakened at the same time each morning and not allowed to sleep outside the prescribed sleep times (Piazza et al., 1997). Five studies have included a bedtime fading component in their interventions for children with ASD (Christodulu & Durand, 2004; DeLeon, Fisher, & Marhefka, 2004; Durand & Christodulu, 2004; Moon, Corkum, & Smith, 2010; Piazza et al., 1997). All of these studies involved children who had problems initiating and/or maintaining sleep. Children with the additional problem of bedtime disturbances were included in two studies (Christodulu & Durand, 2004; Durand & Christodulu, 2004).

Only one study examined faded bedtime without a response cost or specific sleep restriction component (DeLeon et al., 2004). This study involved a 4-year-old boy with ASD and developmental delay who engaged in SIB associated with night wakings. The faded bedtime intervention decreased the number of night wakings and, in so doing, reduced the waking-related SIB.

Two studies examined the effectiveness of FBRC (Moon et al., 2010; Piazza et al., 1997). FBRC involves bedtime fading, as described above. However, if the child does not fall asleep within a certain period of time, FBRC involves the additional component of removing the child from bed (response cost) to increase the motivation to fall asleep. After a predetermined time (typically about 30 min), the child is returned to bed; the procedure is repeated until the child falls asleep. Once successful at the target bedtime, an earlier bedtime is set as the goal.

Each FBRC study examined this intervention in three children with ASD between the ages of 5 and 9 years who had difficulty initiating sleep. In one study, participants were inpatients and the intervention was delivered by caretake on the unit (Piazza et al., 1997). In the other study, the manualized intervention was delivered in-home by parents with the aid of telephone coaching (Moon et al., 2010). Piazza et al.’s sample had difficulties initiating and maintaining sleep as well as severe behavioral problems. The Moon et al. sample had difficulties initiating sleep. In both studies, FBRC effectively reduced sleep onset latency. These improvements were maintained at 3-month (Moon et al., 2010) and 4-month (Piazza et al., 1997) follow-ups. Moon et al. also found some improvement in daytime behavior. Of note, Piazza et al. compared FBRC with bedtime scheduling (i.e., implementing a bedtime routine, consistent bedtime and awakening time, and not allowing the child to sleep at nonprescribed sleep times) and found that for their 14 participants (of whom 5 had ASD), FBRC was superior to bedtime scheduling.

Sleep restriction also involves fading bedtime and resembles FBRC but is based on sleep duration rather than bedtime. It entails limiting the time the child spends in bed to 90% of the child’s baseline total sleep duration, thus restricting the time spent awake in bed. If sleep disturbances show a target decrease, the child’s bedtime is faded (moved 15 min earlier) each week. If the child remains wide awake in bed, he/she is removed from bed and engaged in quiet activities until he/she appears tired. Two studies (each involving one 4-year-old child with ASD) examined the effect of using sleep restriction with positive bedtime routines to reduce bedtime disturbances and night waking (Christodulu & Durand, 2004; Durand & Christodulu, 2004). Both found that the intervention decreased bedtime disturbances and the number and duration of night wakings. Both also showed that the participant slept somewhat less following the intervention, yet parents were more satisfied with their child’s sleep. The Durand and Christodulu (2004) participant also stopped cosleeping after intervention. Despite these improvements, when the sleep-restriction program was introduced, the child exhibited sleepwalking and night terrors, which may have been due to disruption in nonrapid eye movement (NREM) sleep. Furthermore, Christodulu and Durand (2004) reported that the mother experienced difficulty implementing bedtime routines because of her son’s disruptive behavior.

Faded bedtime does not meet criteria to be considered possibly efficacious, although nine individuals with ASD have been found to benefit from a faded bedtime component. The Piazza et al. (1997) and Moon et al. (2010) sample sizes were adequate, but these studies lacked the methodological rigor required to be labeled possibly efficacious. A strength of the Piazza et al. study
was that FBRC was compared to bedtime scheduling. However, the small numbers of children with ASD in these groups (3 vs. 2), made direct comparisons of the effects of these interventions on children with ASD inappropriate. Although an important strength of the Moon et al. study was the use of an objective outcome measure (actigraphy), it used a case series A–B design, which limits one’s ability to rule out many extraneous factors that may have contributed to the improvements. The studies that examined the related interventions of faded bedtime (DeLeon et al., 2004) and sleep restriction (Christodulu & Durand, 2004; Durand & Christodulu, 2004) provide further support for faded bedtime interventions, but also used A–B designs.

**Stimulus Fading**

Stimulus fading specifically targets cosleeping and entails gradually eliminating the presence of a parent from the child’s room. For example, on the first night the parent might sleep on a mattress beside the child’s bed. Progressively over nights, the distance between the child and the parent increases until he/she is faded out of the child’s room. Only two of the reviewed studies incorporated stimulus fading. One was a single-case study of a 5-year-old with ASD (Howlin, 1984). The other (Reed et al., 2009) incorporated multiple intervention components and is discussed separately below. Following intervention, the child in the Howlin study showed an overall decrease in sleep onset latency and reductions in night wakings and cosleeping. Furthermore, the mother reported improvements in her mental health and marital relationship. Given that improvements in sleep have only been demonstrated in one child with ASD following a stimulus fading intervention, this intervention cannot be classified as possibly efficacious.

**Chronotherapy**

Chronotherapy involves systematically delaying bedtime and wake time each day while maintaining a regular schedule during waking hours. This procedure is followed until the individual is going to bed and falling asleep at a desirable time (i.e., the child is put to bed at a progressively later time until bedtime has been reset after having advanced around the clock). Thus, in contrast to faded bedtime, chronotherapy involves delaying (putting to bed later) rather than advancing (putting to bed earlier) bedtime. One study (Piazza, Hagopian, Hughes, & Fisher, 1998) used chronotherapy to treat severe sleep problems in an 8-year-old with ASD. The child exhibited a disrupted sleep-wake schedule characterized by irregular sleep onset times (more than 3 h later than expected), variable wake times, inappropriate daytime ASD, and a short sleep duration (mean of 5.9 h per night). The intervention took place on an in-patient unit. The child’s sleep pattern improved immediately upon introduction of the intervention and an age-appropriate bedtime was achieved in 11 days. The intervention decreased sleep latency and night awakenings and increased total average sleep per night by 2 h. Furthermore, these improvements were maintained in the home at the 4-month follow-up. Since chronotherapy has only been examined in one child with ASD, more research is needed to determine whether this intervention can be considered possibly efficacious.

**Multi-Component Intervention Studies**

Two studies used multi-component interventions (extinction, graduated extinction, stimulus fading, sleep hygiene, visual supports, and reward systems). The protocols involved (a) comparing booklet-delivered behavioral interventions to face-to-face interventions (Montgomery et al., 2004), and (b) group parent education workshops (Reed et al., 2009). Montgomery et al. found both booklet-delivered and face-to-face interventions resulted in decreased sleep onset latency and night wakings. Reed et al.’s intervention decreased bedtime disturbances and improved daytime behavior. Although the ASD samples were relatively large (i.e., 20 and 21, respectively for Montgomery et al., 2004, and Reed et al., 2009), these study designs did not allow tests of specific components and thus cannot be used to establish efficacy of the interventions. Furthermore, Montgomery et al. (2004) did not describe results separately for the 21 children with autism (vs. 45 other “severely learning disabled” participants).

**Conclusions and Future Directions**

Although behavioral interventions are highly effective in improving sleep problems in TD children (e.g., Mindell et al., 2006), relatively few published studies have examined behavioral treatment of sleep problems in children with ASD. No interventions meet criteria to be classified as well-established or probably efficacious. In the review performed by Schreck (2001), only a single behavioral intervention met criteria to be considered possibly efficacious. Over a decade later, only one additional intervention, scheduled awakenings, meets criteria. More specifically, standard extinction may be particularly effective in treating night wakings and cosleeping, whereas scheduled awakenings appear to be effective in reducing night terrors. In order for these
interventions to be considered probably efficacious or well-established interventions, such studies need replication.

Notably, since the review by Schreck (2001), four additional studies have examined the effects of faded bedtime on sleep problems. These studies bring the total number of children showing improvement following this intervention to nine, more than any other behavioral intervention. However, the relevant studies should be interpreted cautiously as they did not include rigorous methodological design controlling for nontreatment-related factors (e.g., attention, expectancy effects). At this point, although some positive outcomes have been reported, there has not been enough research examining faded bedtime, graduated extinction, stimulus fading and chronotherapy to allow any firm conclusions regarding treatment efficacy for children with ASD. More rigorous research, particularly studies with sound methodological designs is required in order for any of these interventions to be considered possibly efficacious.

As this review reveals, despite the high prevalence of sleep problems in children with ASD, evidence for effective treatment is sparse. Among the challenges in conducting this research is the highly variable expression of ASD (e.g., in relation to symptom severity and intellectual abilities) and the high rate of comorbid difficulties. Many of the studies reviewed had heterogeneous samples (e.g., included children with and without ASD) or were limited to one or two children with ASD who often had comorbid conditions. ASD is a particularly complex disorder. For example, recent studies report that 70–72% of children with ASD have at least one co-morbid psychological disorder (e.g., Gjevik, Eldevik, Fjæran-Granum, & Sponheim, 2010; Leyfer et al., 2006; Simonoff et al., 2008). Symptoms associated with attention-deficit hyperactivity disorder and anxiety disorders are among the most prevalent in ASD, which is important to consider as these disorders are also associated with a high prevalence of sleep problems (Corkum, Tannock, & Moldofsky, 1998; Forbes et al., 2008; Mayes & Calhoun, 2009).

Some studies suggest that behavioral interventions need to be adapted to the child’s cognitive and developmental level. For example, Williams et al. (2006) pointed out that a bedtime story may be an inappropriate sleep hygiene technique for children with limited language comprehension. Other studies suggest the importance of considering ASD symptomatology when tailoring the treatment. Kodak and Piazza (2008) suggested incorporating some variety into bedtime routines. Other factors could make certain interventions inappropriate; Wiggs and France (2000) suggested that extinction may not be suitable for children with physical disabilities or SIB. Since there appears to be a relationship between sleep problems and ASD symptomatology, and since children with ASD differ considerably in their symptom expression and level of functioning, studies need to be directed at addressing these issues. The necessity for these modifications, however, hinders the specification and perhaps replicability of treatment and likely contributes to the dearth of published research in this area.

Future studies should also examine methods of treatment delivery. Two studies used manuals to provide distance treatment of sleep problems in children with ASD (Montgomery et al., 2004; Moon et al., 2010). Montgomery et al. (2004) found that booklet-delivered treatment was as effective as the face-to-face, in-home intervention. However, this sample was not exclusively children with ASD. Manuals can provide distance treatment of sleep problems and afford the opportunity to minimize family burden, reach those in rural (or underserved) areas, and are cost-effective (Stamm, 1998). Group (vs. individual) sessions are another method of training parents to implement sleep intervention. Only one study examined group-based parent training for treating sleep problems in children with ASD. Reed et al. (2009) presented small (five per group) parent education workshops to teach the components of their intervention. In addition to being cost-effective, group formats offer opportunities to meet others experiencing similar challenges to discuss difficulties, support each other, and share strategies (Luther, Canham, & Cureton, 2005).

The high prevalence of sleep problems in children with ASD, and the negative consequences of inadequate sleep, make appropriate intervention an urgent priority for many families. The current literature can guide clinicians as it suggests that promoting positive sleep hygiene when combined with standard extinction is likely to improve problems initiating and maintaining sleep in children with ASD, and scheduled awakenings may improve night terrors.

Knowledge of ASD, the characteristics of individual children, and both preferences and competencies of families is necessary to tailor these procedures. The highly variable expression of ASD and the unique needs of children with ASD and their families make conducting large scale research in this area challenging. Although larger sample sizes will undoubtedly help to move this area of research ahead, well-controlled, methodologically rigorous case studies can also make a substantial contribution to our understanding of the effectiveness of behavioral interventions in children with ASD. Current interest in effective intervention for the sleep problems of this group of
children holds promise for the development of better treatments.

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