2013

A comparative analysis of behavioral treatments for addressing sleep interfering behaviors of young children

Chunying Sandy Jin
Western New England University

A Comparative Analysis of Behavioral Treatments for Addressing Sleep Interfering Behaviors of Young Children

A Dissertation

Submitted to the Department of Psychology

in the School of Arts and Sciences at

Western New England University

In Partial Fulfillment of the Requirement for the Degree

Doctor of Philosophy

Chunying Sandy Jin

March 2013

Supervised by:

Gregory P. Hanley, PhD, BCBA-D

Abstract

We investigated the efficacy of and the preference for three behavioral strategies used to reduce sleep interfering behaviors of young children: extinction (EXT), time-based visiting (TBV), and bedtime pass (BTP). We used nighttime infrared video and a parental sleep diary to measure sleep interfering behaviors, sleep onset delay, night awakenings, amount of sleep, as well as other sleep-relevant events. We used a multiple baseline across subjects design to evaluate treatment efficacy across families and a multielement design within each family to compare the three strategies. At the end of the treatment comparison, children were given the opportunity to choose the condition they most preferred; children then experienced the corresponding procedure. Parents also provided feedback on the acceptability of each treatment and on their satisfaction with the process and outcomes. All three treatments resulted in a reduction in sleep interfering behavior, with slight advantage to BTP and EXT. Bedtime pass was associated with higher treatment acceptability by the children and the parents.

Keywords: assessment, autism, bedtime pass, children, extinction, functional assessment, sleep problems, sleep treatment, time-based visiting

A Comparative Analysis of Behavioral Treatments for Addressing Sleep Interfering Behaviors of Young Children

The importance of good sleep is apparent to parents and caregivers who are struggling to put their kids to bed each night. Sleep problems typically involve difficulty falling asleep or staying asleep, frequent or extended episodes of night and early awakenings, noncompliance with bedtime instructions, or problem behaviors that interfere with sleep onset (e.g., crying, calling out, playing in bed). As many as 35% to 50% of typically developing children and 63% to 73 % of children diagnosed with autism experience some type of sleep problems (Johnson, 1991; Polimeni, Richdale, & Francis, 2005; Souders et al., 2009).

A good night's sleep is a key ingredient for children's functioning and affects every aspect of their development and health. There is increasing evidence that sleep problems are associated with unintentional injuries (Koulouglioti, Cole, & Kitzman, 2008), difficult temperament (Richman, 1981), increased risk of obesity (Bell & Zimmerman, 2010; Magee & Hale, 2012), poor school performance (Dewald, Meijer, Oort, Kerkhof, & Bogels, 2010), and behavior problems such as noncompliance, aggression, and self-injury (Wiggs & Stores, 1996). We often overlook the concomitant secondary effect on parents. An array of associated factors including poor parental sleep quality and daytime functioning (Meltzer & Mindell, 2007), maternal depression (Richman, 1981), and marital discord (Chavin & Tinson, 1980) suggest that sleep problems pose harm to family well-being and are highly stressful for parents.

Sleep problems do not subside with age, and the persistence of sleep issues continue to present great challenges to families and clinicians. Zuckerman et al. (1987) reported that 8-month-old children with sleep problems were more likely, than those without, to have sleep problems at the age of 3; Kataria et al. (1987) also reported that 84% of their sample of

children's sleep problems persisted after three years.

One professional resource for parents is their pediatricians. However, pediatricians might not receive adequate support or professional guidance on the handling of sleep issues. A survey of 156 pediatric residency programs found that pediatricians receive on average about 5 hours of instruction on sleep (Mindell, Moline, Zendell, Brown, & Fry, 1994). Although many pediatricians do recommend behavioral treatments, the most popular ones being bedtime routine and the *Ferber method* (i.e., gradually waiting a longer period of time before attending the child following each instance of crying or calling out), approximately 49% of those who were surveyed inform parents that their child is likely to outgrow sleep problems (Mindell et al., 1994). Families need access to better treatments for addressing sleep problems.

Another common treatment recommendation involves medication even though there is very limited research on the efficacy, tolerability, and acceptability of pharmacological intervention, virtually no guidelines for prescribing practices, and no drug approved by the federal drug administration for children's sleep problems (FDA; Rosen, Owens, Scher, & Glaze, 2002). A cross-sectional study conducted by Stojanovski et al. (2007) found that as many as 81% of children's visits to pediatricians, psychiatrists, and family physicians for sleep problems resulted in medication prescription, whereas behavioral intervention was recommended only 22% of the time. A survey conducted by Owens, Rosen, and Mindell's (2003) found that more than 75% of community-based primary-care pediatricians have recommended nonprescription medication for sleep problems and over 50% of them have prescribed medication. Thirty-nine percent of respondents reported medication use for pediatric insomnia, bedtime struggles, and sleep onset delay when these issues may more likely benefit from behavioral interventions. Prescribed drug types range from antihistamine and melatonin to antidepressants, antipsychotics,

remelteon, and benzodiazepines (Hollway & Aman, 2011; Kuhn & Weidinger, 2000; Owens et al., 2003). Melatonin, among other pharmacological interventions, is associated with the strongest empirical support; a small number of studies suggest that melatonin yields statistically significant improvement in children's sleep onset delay (Guenole et al., 2011). However, because data are usually aggregated in these studies as well as in other studies reporting the efficacy of medication, and because the reported average sleep onset delay following intervention still exceeds on hour (Braam, Didden, Smits, & Curfs, 2008; Wright et al., 2011), it is difficult to interpret the extent to which children's sleep has improved to a clinically and socially acceptable level with melatonin administration. All of the aforementioned factors suggest much more research is needed to more clearly assess the role of medication, its associated risks, benefits, and most importantly, its efficacy, tolerability, and acceptability.

Behavioral intervention shows merit as a promising alternative, but has yet to draw the focus of mainstream treatment providers. Several reviews of interventions for pediatric sleep problems suggest that behavioral intervention is associated with the strongest empirical support and long-term efficacy among other available treatment options (see Kuhn & Elliott, 2003; Mindell, 1999; Mindell, Kuhn, Lewin, Meltzer, & Sadeh, 2006). Guided by the assumption that falling asleep is an operant behavior controlled by environmental factors (Bootzin, 1977), interventions are designed to (a) increase the value of sleep or set the occasion for being settled at bedtime, and (b) weaken the contingencies responsible for the maintenance of behaviors like crying, calling out, or playing in bed that interfere with sleep.

Several studies in the sleep literature show the isolated effects of manipulations to some aspect of these contingencies. For example, routines that involve parents arranging a sequence of quiet activities that occur reliably before bed have been shown to be effective in decreasing the

frequency of tantrums and bedtime disturbances of young children (Adams & Rickert, 1989; Christodulu & Durand, 2004; Milan, Mitchell, Berger, & Pierson, 1981). The results of these studies support the utility of enhancing stimulus control over and setting the occasion for behavioral quietude (laying quietly in bed with moving much). Piazza and Fisher (1991a; 1991b), subsequently replicated by Ashbaugh and Peck (1998), increased the amount of appropriate sleep in four individuals with intellectual disabilities (ID) by using a faded bedtime with response cost procedure. This procedure involved (a) pushing the child's bedtime forward initially and fading bedtime back to an earlier time gradually as the child fell asleep within a short period time and (b) keeping the child awake for 1 hr if sleep onset delay was longer than 15 min. The success of this procedure speaks to the versatility of capitalizing on sleep pressure. That is, methods are arranged to make sleep more valuable at the time the child is bid goodnight. Finally, procedures used to decrease sleep interfering behavior such as withholding parental attention following crying or call outs (e.g., France & Hudson, 1990) solidify the act of disrupting the contingency between interfering behavior and its putative reinforcement.

Taken together, these studies show that behavioral intervention is promising, but none were necessarily predicated on an understanding of the conditions surrounding sleep problems of individual participants (i.e., a functional assessment of the problem behavior was lacking). That is, treatments were prescribed without first identifying the types of sleep problems, context under which they occur, and the putative reinforcers maintaining sleep interfering behaviors, when doing so is usually the standard for other types problem behaviors (Hanley, Iwata, & McCord, 2003). We recently demonstrated the efficacy of a comprehensive model for functionally assessing and then treating sleep problems in young children (Jin, Hanley, & Beaulieu, 2013). This model involved (a) identifying variables contributing to the sleep problems of each child

using the Sleep Assessment and Treatment Tool (SATT; an open-ended functional assessment interview), (b) developing individualized interventions based on the idiosyncratic results of the assessment, and (c) synthesizing contingency-based treatments to thoroughly address the sleep problems of each child. The SATT-based intervention was not only successful in decreasing each child's sleep onset delay and sleep interfering behavior based on their unique sleep history and present sleeping conditions, the prescribed intervention was also personally-relevant and socially acceptable. Although we combined different tactics for different children, the design of each comprehensive treatment was based on a thorough contingency analysis; all involved (a) creating a sleep-conducive environment, (b) arranging a healthy routine to set the occasion for sleep, (c) adjusting the child's sleep schedule based on developmental norms and current sleep phases to increase sleep pressure at the time the child was expected to go to bed, (d) eliminating inappropriate sleep dependencies that hindered independent and persistent sleep, (e) creating appropriate sleep dependencies that were consistently available throughout the night, and (f) disrupting the contingencies between interfering behavior and its putative reinforcement.

Although our previous study described a successful model for treating pediatric sleep problems, refinements of the components of this model are needed. We need more analyses of the independent and interactive effects of different treatment options, especially those available for sleep interfering behaviors, because several types of function-based treatments are usually available from which to choose. For example, given a common sleep interfering behavior like crying or calling out maintained by access to parental attention, should the parents simply ignore, should they attend intermittently on a time-based schedule, or should they try to strengthen some alternative form of behavior? These questions cannot be satisfactorily answered because comparative analyses of different treatments for these problems do not yet exist.

Behavior analysts generally use these same three types of function-based treatments to reduce problem behaviors like self-injury, aggression, or classroom disruption: extinction (EXT; e.g., Fisher, et al., 1993), noncontingent reinforcement (NCR; e.g., Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993), and differential reinforcement of alternative behavior (DRA; e.g., Carr & Durand, 1985). EXT involves severing the relation between response and its reinforcer by withholding the reinforcer following each occurrence of problem behavior. Many studies (e.g., Fisher et al. 1993; Iwata, Pace, Kalsher, Cowdery, & Cataldo, 1990) have shown that once the reinforcer is known, extinction can effectively reduce severe problem behavior (e.g., self-injurious behavior, aggression) and is often an integral part of any function-based intervention. However, possible undesirable side-effects including initial bursts in the rate of problem behavior (Lerman & Iwata, 1995) and emotional or aggressive behavior are possible when using extinction.

NCR, on the other hand, involves delivering the reinforcer on a time-based schedule independent of problem behavior. Vollmer et al. (1993) and Vollmer, Marcus, and Ringdahl (1995) showed that NCR-based treatments may attenuate the negative side-effects associated with extinction. Reduction in problem behavior may be a function of the disrupted contingency between response and reinforcer or the removal of establishing operation for problem behavior (Kahng, Iwata, Thompson, & Hanley, 2000). However, there is no explicit teaching of desirable skills when using NCR, and persistence of problem behavior is possible when a sufficient number of reinforcers accidentally follow problem behavior (i.e., adventitious reinforcement; Vollmer, Ringdahl, Roane, & Marcus, 1997).

DRA involves delivering the reinforcer following alternative behaviors, and unlike NCR, does involve explicit teaching of a desirable behavior. When the alternative response results in

the same class of reinforcement maintaining problem behavior and the alternative response is a recognizable form of communication, the procedure is better known as functional communication training (FCT; Tiger, Hanley, & Bruzek, 2008). Carr and Durand (1985) first applied this procedure and taught 4 children diagnosed with autism to request attention or escape via a communicative response. FCT was successful in reducing problem behaviors of aggression, self-injury, and tantrums for all participating children.

Although these procedures have been the subject of much applied, empirical work and comparative analysis, and proven effective in reducing daytime problem behaviors such as aggression and self-injury, the extent to which these treatments work when applied to sleep problems has been evaluated to a much lesser extent. If we assume that sleep interfering behavior is not different in any functional way from other types of problem behaviors, we can hypothesize that these treatments can be extended to problem behaviors that interfere with sleep onset.

There is strong empirical support for the use of EXT to decrease sleep interfering behavior according to the Sackett criteria for evidence-based treatments (Mindell et al., 2006) and the Chambless criteria for well-established intervention (Mindell, 1999) because EXT has been associated with rapid reduction in problem behavior during settling periods. An exemplary study was conducted by France and Hudson (1990), who used EXT in combination with stimulus control procedures to decrease nighttime sleep disturbance of 7 infants. Arranging a regular bedtime routine and withholding interactions from the child after the bid goodnight resulted in a decrease in the number and minutes of night awakenings in all children. However, EXT may be associated with negative side effects and consistent implementation by the parents may be difficult (France & Hudson). The increased frequency and intensity of problem behavior during the implementation of EXT (Lerman & Iwata, 1995) may be difficult for parents to tolerate and

runs the risk of parents giving in and attending to the child. Such fidelity breaches may result in intermittent reinforcement and the inadvertent shaping of more intense forms of problem behavior; however, data clearly supporting this claim are lacking in the sleep literature. Parents may also quickly lose confidence in the procedure and stop implementing it altogether. Therefore, alternatives should be considered. In addition, most studies evaluating the efficacy of EXT lack necessary methodological rigor: some lack of experimental control, but most rely exclusively on parent diaries to detect effects of the intervention (Williams, 1958; Rickert & Johnson, 1988; Seymour, Bayfield, Brock, & Durin, 1983; Seymour, Brock, During, & Poole, 1989). Finally, most studies evaluate EXT in combination with other procedures (France & Hudson, 1990; Rickert & Johnson, 1988); therefore, its independent effects remain largely unknown.

There is a very limited literature on the use of NCR to decrease sleep interfering behaviors of young children. Arranging an NCR procedure at bedtime would involve the delivery of reinforcers (e.g., attention) on a time-based schedule independent of the child's problem behavior at bedtime. Studies using NCR to decrease other problem behavior types suggest that it attenuates the negative side effects associated with EXT (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993; Vollmer et al., 1998) presumably by exerting an abolishing effect on the reinforcer maintaining the problem behavior (Kahng et al., 2000). In the case of sleep, NCR essentially teaches the child that the reinforcer is available while they are in bed and that no behavior is required to access that reinforcer. Elimination of behavior with NCR schedules is consistent with the goal of promoting behavioral quietude, and the allowance of the reinforcer at least some of the time may be more acceptable for both the parents and the child than the complete elimination of the reinforcer. An NCR procedure essentially involves checking on the

child and providing a small amount of the maintaining reinforcer based on time regardless of problem behavior. The procedure is therefore quite different from a more common alternative to extinction called graduated extinction (Adams & Rickert, 1989; Durand & Mindell, 1990). The latter involves gradually increasing the amount of time prior to attending to the child following an instance of problem behavior. In other words, with NCR, the contingency between sleep interfering behavior and its reinforcement is actively disrupted. By contrast, a strong contingency still exists between sleep interfering behavior and problem behavior with graduated extinction.

The independent effects of NCR for sleep interfering behavior have not been thoroughly evaluated; however, O'Reilly et al. (2004) included NCR as part of a treatment package for one child's sleep disturbance. The authors examined the effect of a consistent sleep schedule, stimulus control procedures (consistent routine, removal of toys and books), and visiting the child at a fixed 5-min interval on the number of bedroom exits. Time-based visits combined with the more consistent sleep schedule and stimulus control procedures resulted in less bedroom exits.

The fixed and therefore predictable nature of the visit schedule may have more limited effects than one in which the interval is less predictable to the child and progressively increases. Lalli, Casey, and Kates (1997) used an NCR procedure with progressively increasing time intervals (initial NCR interval was set with sensitivity to baseline performance) that resulted in a decrease in severe problem behavior (aggression, self-injury) for three individuals with developmental disabilities (DD). This sort of NCR procedure in the case of pediatric sleep problems seems appropriate and was implemented with one child diagnosed with autism as part of his comprehensive sleep treatment in Jin, Hanley, & Beaulieu (2013). Parents visited the child based on time regardless of the child's behavior and intervals between visits increased

progressively—this treatment appeared to result in elimination of the child's interfering behavior, but functional control of this aspect of the treatment was not demonstrated. The utility of time-based visiting thus awaits further investigation.

Rather than providing the reinforcer on a time-based schedule, the reinforcer can be provided for an alternative, more desirable behavior. Freeman (2006) and Friman et al. (1999) evaluated the use of a bedtime pass procedure on typically developing children's sleep problems. The pass was exchangeable for brief visits outside of the bedroom and for acceptable requests such as getting a drink or a hug. In both studies, the frequency of crying and leaving the bedroom decreased with the bedtime pass treatment. Freeman (2006) also showed that the use of bedtime pass with extinction was associated with a lower level of crying out and leaving the bedroom than the use of bedtime pass alone. Bedtime pass is essentially a differential reinforcement of alternative behavior procedure because an appropriate alternative form of behavior (use of the pass) results in interaction with the parents or some other reinforcer as opposed to the interfering behavior producing the reinforcing event.

In summary, there are multiple reasons why comparative studies of treatments for sleep interfering behaviors are needed. First, despite the rapid reduction in problem behavior associated with EXT (France & Hudson, 1990), alternatives should be explored so parents can have other function-based treatments from which to choose. Second, existing studies showing the isolated effects of these interventions still rely exclusively on parental reports potentially impacting the validity of the results (France & Hudson, 1990; Freeman, 2006; Friman et al., 1999; O'Reilly et al., 2004; Rickert & Johnson, 1998). We need more studies with the addition of an objective measurement system. Fourth, existing studies evaluating the efficacy of EXT, NCR, and DRA are not necessarily predicated on a functional assessment. We need more studies

that consider the putative reinforcer for the sleep interfering behavior in the design of the interventions. Fifth, although there are a few studies comparing interventions such as positive routines, extinction, scheduled awakenings, and graduated extinction (Adams & Rickert, 1989; France and Blampied, 2005; Rickert & Johnson, 1988), there is no study that directly compares these three treatment options--EXT, NCR, and DRA--for sleep interfering behaviors, and no study has evaluated the comparative efficacy of any different interventions for pediatric sleep problems using single-subject designs. By using single-subject designs, such as multielement designs in which the three treatments are implemented in rapid alternation across successive nights, we can better detect any meaningful differences in the relative efficacy of the treatments. Sixth, the extent to which both parents and children prefer different treatments for sleep interfering behaviors have rarely (parents), or never (children), been considered.

Hanley, Piazza, and Fisher (1997) objectively identified young children's preferred behavioral intervention via a concurrent-chains design. Within this arrangement, preference is detected by measuring the extent to which the child selects a particular stimulus that has been correlated with a particular treatment; the selected treatment is then experienced by the child. Applying this procedure would represent a novel application in the sleep intervention literature and would not only help to identify consumer-friendly interventions but also gives children a voice in the social validation process (Hanley, 2010).

The purpose of the study was to address the aforementioned limitations and to compare the efficacy of three different strategies for treating sleep problems in young children: extinction, NCR via time-based visiting, and DRA via the bedtime pass procedure. We also assessed the extent to which children preferred the experienced treatments via a concurrent-chains schedule and the extent to which parents found each strategy to be acceptable via survey. Our goal was to

identify the optimal components to be included in comprehensive interventions for pediatric sleep problems.

Method

Participants and Settings

Three children, 2- to 3-years of age, and their parents participated in our evaluation. Two children were typically developing and one child was diagnosed with Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). We recruited families from the local community via flyers posted at childcare centers and pediatrician's offices. Following the initial contact from the family, we spoke to parents or primary caregivers over the phone to (a) learn more about the family's concern of their child's sleep, (b) to ensure that there was no severe medical or health concerns related to sleep, and (c) to provide families with some general information about the research study and about the sleep program at Western New England University. The first three families who were available participated in the study. The three participating children were reportedly difficult to settle to bed due to frequent and extended periods of crying, calling out, making requests, and leaving the bedroom. They were also reportedly experiencing delayed sleep onset of greater than 30 min. We visited each family in person to provide more detailed information about the study, to obtain informed consents, and to build rapport with parents. Each family practiced operating the camcorder and filling out the diary prior to collecting baseline data.

Sam was a 2-year-old typically developing boy reported to take a long time to fall asleep. When parents attempted to put him to bed, Sam often ran away, complained, cried, called out, and made requests such as "more story," "more milk," and "stay with me." When Sam woke up in the middle of the night, he would go to his parents' bedroom to sleep. Parents had attempted to

stay in bed with Sam, negotiated bedtime rules with him, locked Sam in his bedroom, or took Sam for a car ride until he fell asleep at bedtime. Sam's sleep problems had persisted for nearly a year and were highly stressful for all family members. Sam's parents reported that they suffered from poor sleep and spousal disagreements as a result of Sam's sleep problems. Parental sleep goals for Sam included reducing sleep interfering behavior (e.g., crying, calling out, leaving the bedroom), having Sam fall asleep independently and stay asleep throughout the night, and having Sam achieve an age-appropriate amount of sleep (11 hr 30 min).

Gina was a 3-year-old typically developing girl reported to take a long time to fall asleep. Parents expressed that Gina made frequent requests at bedtime such as, "Can I have more books, please?" or "Will you stay with me?" When her requests were not granted, Gina often cried or called out for an extended period of time. Parents also reported that Gina woke up in the middle of the night requesting to stay with her parents or telling them that she was scared. Parents had attempted to grant her requests at times and had refused at other times. They had talked to her about bedtime rules, stayed in bed with her until she fell asleep, or reassured her that she was safe in the middle of the night. Gina's parents indicated that her sleep problems had persisted for at least a year and were highly stressful and disruptive to their family life. As a result, Gina's parents were also suffering from poor sleep and spousal disagreements. Parental goals for Gina's sleep included reducing problem behaviors at bedtime that interfered with her sleep, eliminating parental presence and facilitating independent sleep, reducing the amount of time it took for Gina to fall asleep, reducing night awakenings, and achieving an age-appropriate amount of sleep (11 hr 15 min).

Alice was a 3-year-old girl diagnosed with PDD-NOS. When parents put Alice to bed, she reportedly cried, got out of bed, and asked for more milk. Alice reportedly woke up in the

middle of the time at least 3 to 4 times making the same request. Parents had attempted to bargain and reason with Alice, gave in to her requests, or used reprimands. Melatonin, clonidine, and hydroxezine had also been given to Alice for her sleep problems for about 12 months. Alice's mom reportedly experienced poor sleep and depression as a result of Alice's persistent sleep issues. Parental goals for Alice's sleep included reducing the amount of problem behavior during the settling period, reducing the amount of night awakenings, and eliminating medication.

The study took place in the children's homes, and their parents implemented all of the treatment components. Both Gina and Sam slept in their own bedroom with regular beds without rails. Alice slept in her own bed but shared a bedroom with her sister. All three children communicated using sentences, could engage in brief conversations about preferred topics, and could respond appropriately to directions from a parent.

Measurement

Sleep diaries. We asked the parents to observe and record information about their child's sleep each day. Information documented on the sleep diary included the time (a) when the child was bid goodnight, (b) when the child fell asleep, (c) of night awakenings and resumption of sleep (if any), (d) of morning awakening, and (e) of any naps during the day. The sleep diary also included open-ended questions regarding bedtime routine noncompliance, sleep interfering behaviors, parental presence or cosleeping (if any), and the type(s) of sleep medication given (if any).

Infrared nighttime video. We placed a Sony HDR-XR200V 120GB high definition camcorder with infrared illumination at an inconspicuous location (e.g., in between books on a bookshelf) in each child's bedroom to continuously record the child's sleep. Video recordings were used to verify and complement the information obtained from the diary and to obtain

precise measures of problem behaviors that interfered with sleep during bedtime. Parents turned on the camcorder before bidding the child goodnight and turned it off in the morning shortly after beginning the morning routine. Data from the camcorder were then transferred to an external hard drive. Data collectors used AVS video editor to combine video files from each night for data analysis.

Dependent Variables

Sleep interfering behavior was any behavior occurring after bidding goodnight that interfered with falling asleep. Interfering behavior included (a) vocalizations (any audible vocalization coming from the child such as crying, calling out, making requests, talking, singing, giggling, or screaming with the exclusion of sneezing, coughing, or yawning), (b) getting out/staying out of bed (child leaving the bed or not in bed), (c) sitting up (back and head not contacting any part of the bed) or standing in bed, and (d) object manipulation (child's hands actively manipulating items such as books and toys). We used a computer data collection program to collect real-time data of sleep interfering behavior from video recordings. We reported the measure as sleep interfering behavior (in min).

Sleep onset delay was defined as the amount of time (in min) elapsed from when the parents bid the child goodnight to when the child fell asleep. We observed the child from bidding goodnight to falling asleep continuously from the video recordings and used the same data collection program to record the amount of time it took for each child to fall asleep. Observers turned on an assigned key when the child was bid goodnight and turned the key off when 10 min elapsed without any signs of being awake. The 10-min period was subtracted from the sleep onset delay calculation. We reported the measure as sleep onset delay (min).

Once a child fell asleep, we recorded whether the child was awake or asleep using paper

and pencil and a 30-min time sampling procedure. The AVS video editor allowed data collectors to fast-forward the video by moving a cursor on the video timeline to the next interval. The observation period at each sampling interval was 1 min to allow sufficient time to determine whether the child was asleep or awake. Awake was defined as any occurrence of sleep interfering behavior, eyes open if visible, whispering, looking up with head leaving pillow, quiet babbling, quiet humming, or excessive physical movement in bed or under the blanket. Asleep was defined as the child in bed lying on back, stomach, or side without any signs of being awake, or blankets or sheets covering their entire body with minimal physical movement. Night and early waking (in min) was calculated by summing the number of awake intervals after the child fell asleep and multiplying it by 30 min (which was the duration of the time-sampling interval). Any awakenings occurring 1 hr prior to the child's desirable wake time (determined from each child's developmental norms; Ferber, 2006; Weissbluth, 1981) were considered night and early awakenings. Total night sleep (in hrs) was calculated by summing the number of asleep intervals and multiplying it by 30 min. We then calculated percentage of sleep during goal hours by dividing the amount of sleep within the ideal sleep zone by the goal amount of sleep and multiplying the resulting quotient by 100. Ideal sleep zone was determined jointly with parents with sensitivity to the developmentally appropriate amount of sleep.

When determining children's preferences for the behavioral interventions, selections of the cards correlated with different treatments were recorded both on the diary and from the video recordings. Card selection was defined as the child pointing or touching one of the three available cards presented. We reported the measure as number of cumulative selections.

In sum, both diary- and video-based measures were available for sleep onset delay, night awakening, total sleep, and selection responses. Sleep interfering behavior was recorded only via

the video. Finally, we recorded other sleep-relevant events from the diaries including whether the parents stayed with the child in the bed and whether sleep medication was administered.

Interobserver Agreement Analyses

Interobserver agreement (IOA) was assessed by having a second observer independently score at least 20% of baseline and treatment video sessions for all three children. Agreement for sleep onset delay and sleep interfering behavior was calculated by partitioning the observation period (i.e., from bidding goodnight until the child fell asleep) into 10-s intervals and dividing the smaller duration of scored responses by the larger duration within each interval; results were then converted into a percentage and averaged across all intervals. Mean agreement across children for sleep onset delay was 98% (range, 85% to 100%) and 97% (range 81% to 100%) for sleep interfering behavior.

Agreement data for asleep and awake were obtained by comparing two observers' data on an interval-by-interval basis. An agreement was scored in any interval in which both observers scored either awake or asleep and a disagreement was scored in any interval in which one observer scored awake and the other observer scored asleep. Agreement statistics were then calculated by dividing the number of agreement intervals by the number of agreement plus disagreement intervals and multiplying the resulting quotients by 100. Mean agreement across children was 100%.

Procedures

Baseline. Prior to the baseline condition, all children visited their physician to ensure that there were no medical or health-related concerns relevant to the reported sleep problems. At the beginning of the baseline condition, we instructed to parents to continue what they had been doing for their child's sleep.

Assessment. Following the baseline condition, we arranged an open-ended interview with each family using the Sleep Assessment and Treatment Tool (SATT; Jin, Hanley, & Beaulieu, 2013) to identify personal factors contributing to the sleep problems of each child. The SATT is an open-ended functional assessment interview designed to identify the type of sleep problems experienced and the idiosyncratic variables contributing to those problems. From this interview, we were able to obtain information about the history of the child's sleep problems, goals for the child's sleep, the nature of the child's sleep problems and the conditions under which problems occurred, child's current sleep dependencies and sleep schedule, and the types of interfering behaviors and their putative reinforcers. Information from the interview and video-based observations informed the design of comprehensive sleep treatments for each child. We educated parents about good sleep, how sleep problems develop and are exacerbated, and the rationale for selecting a particular type of intervention for different sleep problems. Parents participated in the process of treatment design and selection. The personalized elements of the intervention package remained constant every night while we conducted the comparative evaluation of the three treatments designed to disrupt the contingency between interfering behavior and its reinforcer.

Parent training. Following the design of the comprehensive treatments, we arranged a 2-hr parent training session with parents of each child to discuss the rationale and the specifics of each treatment component. Training took place in the participating families' homes. We used behavior skills training consisting of instructions, modeling, role play, and feedback to ensure that parents could correctly implement all the treatment components. The first author pretended to be the child who was crying and calling out during role play and parents practiced implementing the three treatments to be compared (e.g., how to ignore, guide back with minimal

interaction, or instruct pass use) until performance was correct and independent. We were available for questions or concerns via phone each day and visited the families at least two times per week to pick up the diary and video data. These visits also served as opportunities to provide support for the family, provide feedback on their performance, and maintain a positive relationship with family members.

Comparative Evaluation

Personalized elements within the comprehensive treatment were held constant every night while we conducted a comparative analysis of the three treatments for interfering behavior. The constancy of the personalized components helped to (a) isolate the effects of treatments being compared and (b) ensure intervention was thoroughgoing to maximize treatment gains. Although the prescribed intervention for each child differed based on the idiosyncratic results of our assessment, all involved (a) adjusting the sleep schedule based on developmental norms and current sleep phases to capitalize on sleep pressure (i.e., establish the value of sleep), (b) arranging relaxing pre-sleep routines to set the occasion for sleep, (c) adjusting the ambient environment to be sleep-conducive, and (d) ensuring healthy sleep dependencies that were constantly available during the night to occasion falling asleep or resumption of sleep.

Specific changes for Sam included providing access to toys and books for 30 min prior to bedtime, arranging a quiet story time consisting of social interaction with parents just prior to bidding goodnight, bidding Sam goodnight around his current sleep phase at the start of the intervention and gradually moving the bedtime earlier, and placing a white-noise sound machine that stayed on in the bedroom throughout the night. Changes for Alice included providing access to a moderate amount of milk (i.e., 4 ounces) prior to bedtime, scheduling an activity time (e.g., drawing) with mom, story time just prior to bed, and placing a white-noise sound machine that

stayed on in the bedroom throughout the night. Specific changes for Gina included arranging a story time consisting of quiet social interaction with parents prior to bedtime, gradually dimming the bedroom lights, arranging the preferred blanket or stuffed animal to be available only at nighttime, having a cleanup routine for toys and books prior to bedtime and make these items inaccessible throughout the night, and restricting the amount of day sleep to 30 min or less.

Parents implemented the personalized components each night while randomly alternating among the three treatments designed to disrupt the contingency between sleep interfering behavior and its reinforcer. They were extinction (EXT), time-based visiting (TBV), and bedtime pass (BTP). Salient cues were correlated with each treatment condition (Hanley et al., 1997). We used 22 cm by 28 cm colored cards with distinct stimuli representing each condition placed on the cards. For EXT nights, we kept the colored card blank. For TBV nights, a picture of a clock was on the card. For BTP nights, a picture of the child's bedtime pass was on the card.

Each night began with the parent prompting the child to touch one specific card from those concurrently available on the child's door; parents then described what would happen with the treatment that corresponded to the selected card. The selected card was hung on the child's bedroom door facing in so it was visible to the child at all times. The card that the parent prompted the child to select each night was randomly determined across all nights, but we used counterbalancing so that the amount of experience with each treatment was kept the same. After every three nights, we randomly determined from a random number generator (with numbers 1 to 3) the order of the three treatments. Treatments were thus compared within a multielement design, and this efficacy evaluation ended after at least 6 alternations (18 nights total) and when clear patterns in the data were evident via visual inspection.

Extinction (EXT). On EXT nights, the putative reinforcer was withheld following child's

sleep interfering behavior. Before implementing this treatment, parents instructed, “Tonight, I want you to get a good night’s sleep” and bid the child goodnight with a hug and kiss. Parents then left the bedroom immediately, ignored all instances of child’s call-out, cry, or requests, and did not return unless illness was suspected (France & Hudson, 1990). If the child got out of bed, parents gently guided them back with minimal eye contact, minimal language, and a neutral facial expression.

Time-based visiting (TBV). On TBV nights, the putative reinforcer was provided on a time-based schedule independent of child’s interfering behavior. Prior to the terminal link, parents said to the child, “Tonight, I am going to come check on you sometimes” and bid the child goodnight with a hug and kiss. Parents then visited the child at scheduled time-based intervals until they fell asleep (e.g., 5 sec, 10 sec, 1 min, 5 min, 10 min, and 30 min). Time until the first visit was set to equal the shortest latency to interfering behavior from bidding goodnight observed in baseline; subsequent inter-visit intervals progressively increased. Scheduled visits for all children were (1 sec, 5 sec, 10 sec, 1 min, 5 min, 10 min, and 30 min). At each visit, parents simply walked into the bedroom, checked on the child briefly with minimal interaction, re-tucked them in as needed, and bid them goodnight. Visits were discontinued as soon as the child fell asleep. If the child left the bedroom in between parents’ visits, parents immediately guided them back with minimal interaction and bid them goodnight again to reinitiate the sleep sequence. No visits were skipped as a function of the child leaving the bedroom in between visits. If the child was still awake after 30 min, we instructed the parents to continue visiting at 30 min intervals. This procedure was essentially a noncontingent reinforcement (NCR) procedure with progressively increasing intervals set based on baseline performance (Lalli et al., 1997).

Bedtime pass (BTP). On BTP nights, the putative reinforcer was available contingent upon an appropriate alternative behavior (Friman et al., 1999). Prior to bidding goodnight, parents verbally instructed:

> Tonight, I am going to give you this pass. You can use this pass for a trip outside of your bedroom. You can get a drink or get a hug, but you can't stay longer than a few minutes. When you are done using the pass, you must give it back to me.

Parents then gave the pass to the child, bid the child good night with a hug and kiss, and left the bedroom. The pass was a 10 cm by 15 cm laminated card with the words "Gina's (or Sam's and Alice's) bedtime pass." When the child left the bed and handed the pass to a parent, a parent provided brief access to the requested item or activity for approximately 3 min. The pass was then surrendered and parents guided the child back to the bedroom and bid them goodnight. All subsequent instances of crying or call outs were ignored. If the child left the bedroom without the pass, parents reminded him/her that the pass is needed and prompted pass use. The BTP was essentially a differential reinforcement of alternative (DRA) procedure in which only an appropriate alternative behavior (i.e., the use of a pass) resulted in access to the reinforcer.

Social acceptability. After the efficacy evaluation, we assessed child preference by giving children an opportunity to choose the treatment they would experience that night. With the three cards simultaneously available, the parent asked the child to "Pick the one that he or she liked the best." As soon as the child made a selection, the parents carried out procedures associated with the selected treatment. Parents kept the placement of the cards random each night. We continued the assessment until the child made the same selection on three or more consecutive nights or until a pattern of undifferentiated responding across 18 selections. This concurrent-chains arrangement to identify treatment preference was proven to be effective in a

number of studies (see Hanley, 2010), but represented a novel application in the sleep intervention literature.

We also assessed treatment preference with parents via a closed and open-ended survey (see Appendix B), which was administered at the end of the treatment comparison. We asked parents to rate and comment on the acceptability of each of the three treatments and rank them in the order of preference. We also administered a general social validity questionnaire (see Appendix C) to the parents at the end of the consultation to assess whether the comprehensive treatment package resulted in socially meaningful changes for each family. Parents rated on a scale of 1 to 7 and commented on the extent to which they found the assessment procedures acceptable, treatment package acceptable, improvement in their child's sleep satisfactory, and our sleep consultation helpful.

Experimental Design

We used a non-concurrent multiple baseline across subjects design to evaluate the efficacy of the comprehensive treatments. We used a multielement design to compare the efficacy of three different treatments for addressing the sleep interfering behaviors of each child. A concurrent-chains schedule was used to determine children's relative preference for EXT, BTP, and TBV.

Results

Effect on Interfering Behavior

Figure 1 shows sleep interfering behavior (from video data) for the three children. Sam's sleep interfering behavior (top panel) was highly variable in the baseline condition. Following treatment, there was an overall decrease in sleep interfering behavior. Performance was similar across all three conditions during comparative evaluation.

Alice's sleep interfering behavior (middle panel) during the med phase was at a low level with little variability. Alice was given 3 mg of melatonin, 0.1 mg of clonidine, and 0.4 ml of hydroxyzine to address her sleep problems. Sleep interfering behavior increased and was highly variable when medication was withdrawn in the baseline condition. There was an overall decrease in sleep interfering behavior following behavioral intervention and performance was similar across all three types of treatments.

Gina's interfering behavior (bottom panel) was highly variable in the baseline condition. There was a decrease in both the level and variability of interfering behavior in the EXT and BTP conditions. Performance was more variable on nights during which parents implemented TBV.

Effect on Sleep Onset Delay

Figure 2 shows the results of sleep onset delay measured from sleep diaries (left panels) and video (right panels). Both Sam's and Alice's sleep onset delay was highly variable in baseline (in the no medication phase for Alice). Sleep onset delay fell within the target range on more nights during behavioral intervention but performance remained variable. There was an overlap of data among the three treatments.

Gina's sleep onset delay (bottom panel) was also highly variable in the baseline condition. Variability remained during the treatment comparison; however, EXT and BTP conditions were associated with fewer minutes of sleep onset delay. Performance under the TBV condition was more variable. A similar pattern of responding was observed for diary- and video-based data.

Effect on Night and Early Waking

The effect of treatment on night and early waking are depicted on Figure 3. There was a

decrease in the amount of awakenings at night following behavioral intervention for all children. We did not observe consistent difference in the amount of night and early awakenings across the three treatments.

Percentage of Sleep During Goal Hours

Figure 4 shows the results of percentage of sleep during goal hours. For both Sam and Alice, performance was similar across the three conditions. For Gina, EXT and BTP conditions were associated with less variability in the percentage of sleep during goal hours.

Effect on Sleep Goals Across All Measures

Figure 5 depicts whether the sleep goals were met across multiple sleep-related measures for each child and provides a convenient profile of the extent to the child was a better sleeper following treatment. Depicted measures for each child include sleep interfering behavior, sleep onset delay, night and early awakenings, percentage of sleep during goal hours, and parental presence. Additional measures represented for Alice are the use of melatonin (3 mg), clonidine (0.1 mg), and hydroxyzine (0.4 ml). The criteria for meeting the sleep goals were: less than 5 min of sleep interfering behavior, less than 30 min of sleep onset delay, 0 min of night and early awakenings, greater than 90% of goal sleep, absence of parental presence, and absence of all medications (Alice). Across all three children, there were more nights during which sleep goals were met in the treatment condition in comparison to the baseline (*M* percentage of sleep goals met for first 10 baseline nights = 32%, 36%, 24% for Sam, Alice, and Gina respectively; *M* percentage of sleep goals met for last 10 treatment nights = 72%, 95%, 80% for Sam, Alice, and Gina), and there was a complete elimination of parental presence following treatment.

Social Acceptability

The cumulative initial-link selections during the preference assessment are depicted on Figure 5. Sam demonstrated preference for BTP after 14 sessions of undifferentiated selection. Gina showed exclusive preference for BTP. In sum, both children preferred BTP over TBV and EXT. The fewest number of initial-link selections were made to EXT (only 2 selections). Alice showed preference for a reinforcement-based procedure (BTP or TBV) after 5 sessions of undifferentiated selection (i.e., she too avoided the extinction treatment).

Parents' relative rankings of the three treatment conditions are represented in Table 1. The most preferred strategy differed across parents, and each of the three strategies was most preferred by at least one of the parents. Parents' absolute ranking of the three treatment conditions are represented in Table 2. Across four parents, mean ranking for BTP was 6.8 (range 6 to 7), for TBV was 6 (range 4 to 7), and for EXT was 6.5 (range 5 to 7).

Parents' comments regarding BTP, TBV, and EXT are noted on Tables 3, 4, and 5. In general, parents commented favorably for BTP and noted that the pass gave the child some degree of control over that which they desired.

Questions and results of the more general social validity questionnaire administered to the parents at the end of treatment are reported in Table 6. On a Likert scale of 1 to 7, the mean rating across all four questions was 7, meaning that parents (a) found the assessment procedures highly acceptable, (b) found the treatment package highly acceptable, (c) were highly satisfied with the amount of improvement seen in the child's sleep, and (d) found the sleep consultation to be very helpful.

Discussion

Our primary purpose was to determine which of the three treatments--EXT, BTP, or

TBV--was most effective in reducing sleep interfering behavior of young children. For Sam and Alice, we did not observe a consistent difference in the amount of sleep interfering behavior across the three treatments. For Gina, both EXT and BTP conditions were associated with fewer minutes of sleep interfering behaviors, sleep onset delay, night and early awakenings, and a higher percentage of sleep during goal hours. Performance was more variable and less satisfactory under the TBV condition.

Another purpose of our study was to determine the preference for the three types of treatments. Both Sam and Gina preferred the BTP over the other two conditions and EXT was the least preferred treatment for all children. Alice demonstrated preference for both BTP and TBV over EXT. Results of the preference assessments of Sam and Gina are similar to those of Hanley et al. (1997) who showed that while both DRA and NCR procedures reduced destructive behavior of 2 children, both children in Hanley et al. preferred the DRA procedure over the NCR and EXT procedures. Children's preference for contingent over noncontingent reinforcement was similarly observed in Luczynski and Hanley (2009, 2010). As asserted by these authors, it is possible that children prefer differential reinforcement based treatments like BTP over EXT and NCR because the children can access reinforcement at times it is most valued with differential reinforcement based treatments like BTP.

A third purpose of our study was to determine parents' preference for the three treatments addressing interfering behavior. Parents' ranking of the three treatments differed. Parents of Sam and Gina ranked either BTP or TBV as the most preferred strategy whereas Alice's parent ranked EXT as the most preferred strategy. The idiosyncrasy of parental ranking of the three treatments is interesting. Possible variables that could influence parental acceptability over the treatments might include response effort, the extent to which their children find each strategy

acceptable, and family context (e.g., other matters a parent might need to attend to). A closer look at parents' comments regarding each of the three treatments revealed that, in general, parents liked that the BTP gave their children some degree of control at bedtime and that they learned to hand in the pass instead of crying. Gina's mom commented the Gina no longer used the pass and felt comfortable simply having it near her. As for TBV, both Sam's mom and Alice's mom commented that they liked being able to check on their child. However, Alice's mom and Gina's mom commented that it was relatively effortful to implement. Both Sam's mom and Gina's mom commented that they worried that excessive bids for interaction would occur when they visited. General comments for EXT included apprehension about the child's crying. However, three of the four parents commented on the ease of implementation associated with EXT.

Taking all efficacy measures as well as parental and child preference into account, it appears that the BTP is the optimal treatment. BTP was an effective treatment for sleep interfering behavior across all three children. All three children and four parents found it to be socially acceptable. BTP was also associated with the highest mean absolute ranking (see Table 2). BTP is essentially a DRA procedure. Like any DRA procedure, BTP teaches children a desirable alternative response to access their reinforcers. Although there is an extinction component, because at least some amount of reinforcer is accessible, the procedure appears to be more socially acceptable to the children experiencing treatment as well as to the majority of parents implementing the treatment. We recommend that future researchers evaluate the efficacy of variants of BTP, such as when multiple passes are provided initially and then progressively faded based on the child use. The initial number of passes given can be based on the child's baseline performance, and this change may improve the efficacy of and preference for BTP.

Taking all efficacy measures as well as parental and child preference into account, it appears that the TBV is the least optimal treatment. Gina's performance under the TBV condition was more variable. One explanation for this variability for Gina might be adventitious reinforcement resulting from parents' time-based visits inadvertently strengthening sleep interfering behavior. Calculating the extent to which parents' visits coincided with Gina's sleep interfering behavior would help to answer the question of adventitious reinforcement. Another explanation for the persistence of interfering behavior under TBV is that the presence of parents or the act of leaving exerted discriminative control over interfering behavior, and therefore, occasioned crying, calling out, and requests when parents when left after a visit. This outcome was somewhat surprising especially in light of the successful effects of TBV with the participant Lou from Jin et al. (2013). Although we used an NCR schedule with progressively increasing intervals, reinforcement duration (visit period) was very brief. Parents were simply instructed to tuck the child in and bid goodnight. We may have therefore failed to completely abolish the value of the reinforce during visits. Future studies should address these limitations and possibly increase treatment efficacy and acceptability by (a) ensuring that a sufficient amount of time-based reinforcement is present in order to abolish its value, and (b) preventing adventitious reinforcement by omitting visits immediately after interfering behavior. Identifying optimal parameters of this treatment seems important because reinforcement and parental access is at least sometimes available. NCR also attenuates side effects associated with EXT, and problems associated with treatment integrity might be more tolerable than those associated with EXT (Vollmer et al, 1993). Future studies should also consider combining BTP and TBV for children who engage in excessive amount of crying and calling out and for parents who have a difficult time leaving their child in the bedroom (similar to that implemented by Goh, Iwata, & DeLeon,

2000,. for daytime self-injurious behaviors). Doing so may further increase the efficacy and treatment acceptability of behavioral intervention for sleep interfering behaviors.

EXT was efficacious in the present study; these results are consistent with those reported by France and Hudson (1990). Parents commented on their apprehension about the child's unattended crying with EXT; however, an interesting finding in the present study was that most parents found it to be easier to implement than the other two treatments. Because of the idiosyncrasy of parental acceptability of treatments, we recommend practitioners continue to offer parents multiple interventions from which to choose, including EXT, and discuss the relative advantages and disadvantages of each so that parents can make informed decisions and recognize that there are multiple pathways to achieving behavioral quietude with their children.

The SATT-based treatments resulted in the parents achieving all of their goals regarding their children's sleep. There was a decrease in the amount of sleep interfering behavior and night and early awakenings, and an increase in the percentage of sleep during goal hours following implementation of the comprehensive behavioral intervention for all children. This effect was evident via both diary and video measures. Because similar patterns of responding have been observed from both diary and video-based measurement systems in both this study and in Jin et al. (2013), a more practical approach to measurement might involve relying primarily on sleep diaries and using videos more intermittently to verify information obtained from the parents. In addition to decreasing sleep onset delays and interfering behavior, there was a complete elimination of parental presence and all of Alice's sleep medications following treatment. It is also important to note that parents reported high levels of satisfaction with the assessment procedures, treatment packages, improvements in their child's sleep, and the overall consultation process. These results replicate our findings from a previous evaluation (Jin et al., 2013), which

demonstrated that personalized sleep treatments based on the results of the SATT are both efficacious and socially acceptable. Treatments that are designed based on a thorough functional assessment process and that involve changes to all aspects of contingencies influencing both behavioral quietude and sleep interfering behavior are probably the reasons why all parents in both studies reported that they were highly satisfied with the amount of behavior change at the conclusion of the consultations.

We believe that more micro-analytic evaluations are needed to identify the ideal components to be included within the comprehensive treatments, but, as shown in the present study, such evaluations need not be conducted independent of comprehensive intervention. That is, more studies on treatment comparisons are possible if important components of treatment that are not being compared are held constant each night. We also believe that it is especially important to design comparative studies to determine the independent and interactive effects of behavioral interventions and melatonin on the sleep measures included in the current study. Finally, it is important to refine these procedures so that they could be readily adopted by mainstream practitioners. The elimination or at least the minimization of unproven and potentially harmful psychotropic medication use with children depends on the tailoring of function-based assessment and comprehensive intervention for more mainstream application.

References

Adams, L. A., & Rickert, V. I. (1989). Reducing bedtime tantrums: Comparison between positive routines and graduated extinction. *Pediatrics, 84*, 756-761.

Ashbaugh, R., & Peck, S. M. (1998). Treatment of sleep problems in a toddler: a replication of the faded bedtime with response cost protocol. *Journal of Applied Behavior Analysis, 31*, 127-129.

Bell, J. F., & Zimmerman, F. J. (2010). Shortened nighttime sleep duration in early life and subsequent childhood obesity. *Archives of Pediatrics & Adolescent Medicine, 164*, 840-845.

Blampied, N. M., & France, K. G. (1993) A behavioral model of infant sleep disturbance. *Journal of Applied Behavior Analysis, 26*, 477-492.

Bootzin, R. R. (1977). Effects of self-control procedures for insomnia. In R. B. Stuart (Ed.), *Behavioral self-management strategies, techniques and outcomes* (pp. 176-195). New York: Brunner/Mazel.

Braam, W., Didden, R., Smits, M., & Curfs, L. (2008). Melatonin treatment in individuals with intellectual disability and chronic insomnia: a randomized placebo-controlled study. *Journal of Intellectual Disability Research, 52*, 256-264.

Carr, E. G., & Durand, V. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*, 111-126.

Chavin, W., & Tinson, S. (1980). The developing child: children with sleep difficulties. *Health Visitor, 53*, 477-480.

Christodulu, K. V., & Durand, V. M. (2004). Reducing bedtime disturbance and night waking using positive bedtime routines and sleep restriction. *Focus on Autism and Other*

Developmental Disabilities, 19, 130-139.

Dewald, J. F., Meijer, A. M., Oort, F. J., Kerkhof, G. A., & Bogels, S. M. (2010). The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: A meta-analytic review. *Sleep Medicine Review, 14*, 179-189.

Durand, V. M., & Mindell, J. A. (1990). Behavioral treatment of multiple childhood sleep disorders: Effects on child and family. *Behavior Modification, 14*, 37-49.

Ferber, R. (1985). *Solve your child's sleep problems.* New York: Simon & Schuster, Inc.

Fisher, W., Piazza, C., Cataldo, M., Harrell, R., Jefferson, G., & Conner, R. (1993). Functional communication training with and without extinciton and punishment. *Journal of Applied Behavior Analysis, 26*, 23-36.

France, K. G., & Blampied, N. M. (2005). Modifications of systematic ignoring in the management of infant sleep disturbance: Efficacy and infant distress. *Child & Family Behavior Therapy, 27*, 1-16.

France, K. G., & Hudson, S. M. (1990). Behavior management of infant sleep disturbance. *Journal of Applied Behavior Analysis, 23*, 91-98.

Freeman, K. A. (2006). Treating bedtime resistance with the bedtime pass: A systematic replication and component analysis with 3-year-olds. *Journal of Applied Behavior Analysis, 39*, 423-428.

Friman, P. C., Hoff, K. E., Schnoes, C., Freeman, K. A., Woods, D. W., & Blum, N. (1999). The bedtime pass: an approach to bedtime crying and leaving the room. *Archives of Pediatrics & Adolescent Medicine, 153*, 1027-1029.

Guénolé, F., Godbout, R., Nicolas, A., Franco, P., Claustrat, B., & Baleyte, J.-M. (2011). Melatonin for disordered sleep in individuals with autism spectrum disorders: Systematic

review and discussion. *Sleep Medicine Reviews, 15,* 379-387.

Goh, H. L., Iwata, B. A., & DeLeon, I. G. (2000). Competition between noncontingent and contingent reinforcement schedules during response acquisition. *Journal of Applied Behavior Analysis, 33,* 195-205.

Hanley, G. P. (2010). Identifying effective and preferred behavior-change programs: A case for the objective measurement of social validity. *Behavior Analysis in Practice, 3,* 13-21.

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: a review. *Journal of Applied Behavior Analysis, 36,* 147-185.

Hanley, G. P., Piazza, C. C., Fiser, W. W., Contrucci, S. A., & Maglieri, K. M., (1997). Evaluation of client preference for function-based treatments. *Journal of Applied Behavior Analysis, 30,* 459-473.

Hollway, J. A., & Aman, M. G. (2011). Pharmacological treatment of sleep disturbance in developmental disabilities: A review of the literature. *Research in Developmental Disabilities, 32,* 939-962.

Iwata, B. A., Pace, G. M., Kalsher, M. J., Cowdery, G. E., & Cataldo, M. F. (1990). Experimental analysis and extinction of self-injurious escape behavior. *Journal of Applied Behavior Analysis, 23,* 11-27.

Jin, C. S., Hanley, G. P., & Beaulieu, L. (in press) An individualized and comprehensive approach to treating sleep problems in young children. *Journal of Applied Behavior Analysis.*

Johnson, C. M. (1991). Infant and toddler sleep: A telephone survey of parents in one community. *Journal of Developmental and Behavioral Pediatrics, 12,* 108-114.

Kahng, S., Iwata, B. A., Thompson, R. T., & Hanley, G. P. (2000). A method for identifying satiation versus extinction effects under noncontingent reinforcement schedules. *Journal of Applied Behavior Analysis, 33*, 419-432.

Kataria, S., Swanson, M. S., & Trevathan, G. E. (1987). Persistence of sleep disturbances in preschool children. *The Journal of Pediatrics, 110*, 642-646.

Koulouglioti, C., Cole, R., & Kitzman, H. (2008). Inadequate sleep and unintentional injuries in young children. *Public Health Nursing, 25*, 106-114.

Kuhn, B. R., & Elliott, A. J. (2003). Treatment efficacy in behavioral pediatric sleep medicine. *Journal of Psychosomatic Research, 54*, 587-597.

Kuhn, B. R., & Weidinger, D. (2000). Interventions for infant and toddler sleep disturbance: A review. *Child & Family Behavior Therapy, 22*, 33-50.

Lalli, J. S., Casey, S. D., & Kates, K. (1997). Noncontingent reinforcement as treatment for severe problem behavior: some procedural variations. *Journal of Applied Behavior Analysis, 30*, 127-136.

Lerman, D. C. & Iwata, B. A. (1993). Descriptive and experimental analysis of variables maintaining self-injurious behavior. *Journal of Applied Behavior Analysis, 26*, 293-319.

Luczynski, K. C., & Hanley, G. P. (2009). Do children prefer contingencies? An evaluation of the efficacy of and preference for contingent versus noncontingent social reinforcement during play. *Journal of Applied Behavior Analysis, 42*, 511-525.

Luczynski, K. C., & Hanley, G. P., (2010). Examining the generality of children's preference for contingent reinforcement via extension to different responses, reinforcers, and schedules. *Journal of Applied Behavior Analysis, 43*, 397-409.

Magee, L. & Hale, L. (2012). Longitudinal associations between sleep duration and subsequent

weight gain: A systematic review. *Sleep Medicine Reviews, 16*, 231-241.

Meltzer, L. J., & Mindell, J. A. (2007). Relationship between child sleep disturbances and maternal sleep, mood, and parenting stress: A pilot study. *Journal of Family Psychology, 21*, 67-73.

Milan, M. A., Mitchell, Z. P., Berger, M. I., & Pierson, D. F. (1981). Positive routines: A rapid alternative to extinction for elimination of bedtime tantrum behavior. *Child Behavior Therapy, 3*, 13-25.

Mindell, J. A. (1999). Empirically supported treatments in pediatric psychology: Bedtime refusal and night wakings in young children. *Journal of Pediatric Psychology, 24*, 465-481.

Mindell, J. A., Kuhn, B., Lewin, D. S., Meltzer, L. J., & Sadeh, A. (2006). Behavioral treatment of bedtime problems and night wakings in infants and young children. *Sleep: Journal of Sleep and Sleep Disorders Research, 29*, 1263-1276.

Mindell, J. A., Moline, M. L., Zendell, S. M., Brown, L. W., & Fry, J. M. (1994). Pediatricians and sleep disorders: Training and practice. *Pediatrics, 2*, 194-200.

O'Reilly, M. E., Lancioni, G. E., Sigafoos, J. (2004). Using paired-choice assessment to identify variables maintaining sleep problems in a child with severe disabilities. *Journal of Applied Behavior Analysis, 94(2),* 209-212.

Owens, J. A., Rosen, C. L., & Mindell, J. A. (2003). Medication use in the treatment of pediatric insomnia: Results of a survey of community-based pediatricians. *Pediatrics, 111*, 628.

Piazza, C. C., & Fisher, W. W. (1991a). A faded bedtime with response cost protocol for treatment of multiple sleep problems in children. *Journal of Applied Behavior Analysis, 24*, 129-140.

Piazza, C. C., & Fisher, W. W. (1991b). Bedtime fading in the treatment of pediatric insomnia.

Journal of Behavior Therapy and Experimental Psychiatry, 22, 53-56.

Polimeni, M. A., Richdale, A. L., & Francis, A. J. P. (2005). A survey of sleep problems in autism, Asperger's disorder and typically developing children. *Journal of Intellectual Disability Research, 49*, 260-268.

Richman, N. (1981). A community survey of characteristics of one- to two- year-olds with sleep disruptions. *Journal of the American Academy of Child Psychiatry, 20*, 281-291.

Rickert, V. I., & Johnson, C. M. (1988). Reducing nocturnal awakening and crying episodes in infants and young children: A comparison between scheduled awakenings and systematic ignoring. *Pediatrics, 81*, 203-212.

Rosen, C. L., Owens, J. A., Scher, M. S., & Glaze, D. G. (2002). Pharmacotherapy for pediatric sleep disturbances; Current patterns of use and target populations for controlled clinical trials. *Current Therapeutic Research, 63*, B53-B66.

Seymour, F. W., Bayfield, G., Brock, P., & During, M. (1983). Management of night-waking in young children. *Australian Journal of Family Therapy, 4*, 217-222.

Seymour, F. W., Brock, P., During, M., & Poole, G. (1989). Reducing sleep disruptions in young children: Evaluation of therapist-guided and written information approaches: A brief report. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 30*, 913-918.

Souders, M. C., Mason, T. B. A., Valladares, O., Bucan, M., Levy, S. E., Mandell, D. S., . . . Pinto-Martin, J. (2009). Sleep behaviors and sleep quality in children with autism spectrum disorders. *Sleep: Journal of Sleep and Sleep Disorders Research, 32*, 1566-1578.

Stojanovski, S. D., Rasu, R. S., Balkrishnan, R., & Nahata, M. C. (2007). Trends in medication prescribing for pediatric sleep difficulties in US outpatient settings. *Sleep: Journal of*

Sleep and Sleep Disorders Research, 30, 1013-1017.

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice, 1,* 16-23.

Vollmer, T. R., Iwata, B. A., Zarcone, J. R., Smith, R. G., & Mazaleski, J. L. (1993). The role of attention in the treatment of attention-maintained self-injurious behavior: noncontingent reinforcement and differential reinforcement of other behavior. *Journal of Applied Behavior Analysis, 26,* 9-21.

Vollmer, T. R., Marcus, B. A., & Ringdahl, J. E. (1995). Noncontingent escape as treatment for self-injurious behavior maintained by negative reinforcement. *Journal of Applied Behavior Analysis, 28,* 15-26.

Vollmer, T. R., Progar, P. R., Lalli, J. S., Van Camp, C. M., Sierp, B. J., Wright, C. S., . . . Eisenschink, K. J. (1998). Fixed-time schedules attenuate extinction-induced phenomena in the treatment of severe aberrant behavior. *Journal of Applied Behavior Analysis, 31,* 529-542.

Vollmer, T. R., Ringdahl, J. E., Roane, H. S., & Marcus, B. A. (1997). Negative side effects of noncontingent reinforcement. *Journal of Applied Behavior Analysis, 30,* 161-164.

Weissbluth, M., Poncher, J., Given, G., Schwab, J., Mervis, R., & Rosenburg, M. (1981). Sleep duration and television viewing. *Journal of Pediatrics, 99,* 486-488.

Wiggs, L., & Stores, G. (1996). Severe sleep disturbance and daytime challenging behaviour in children with severe learning disabilities. *Journal of Intellectual Disability Research, 40,* 518-528.

Williams, C. D. (1958). The elimination of tantrum behavior by extinction procedures. *Journal of Abnormal Social Psychology, 59,* 269.

Wright, B., Sims, D., Smart, S., Alwazeer, A., Alderson-Day, B., Allgar, V., . . . Miles, J. (2011). Melatonin versus placebo in children with autism spectrum conditions and severe sleep problems not amenable to behaviour management strategies: A randomised controlled crossover trial. *Journal of Autism and Developmental Disorders, 41*, 175-184.

Zuckerman, B., Stevenson, J., & Bailey, V. (1987). Sleep problems in early childhood: Continuities, predictive factors, and behavioral correlates. *Pediatrics, 80*, 664.

Table 1

Results of Social Acceptability Questionnaire Administered to Parents

	Sam		Alice	Gina
Ranking	Mom	Dad	Mom	Mom
1	Time-based Visiting	Bedtime Pass	Extinction	Bedtime Pass
2	Bedtime Pass	Extinction	Bedtime Pass	Extinction
3	Extinction	Time-based Visiting	Time-based Visiting	Time-based Visiting

Note. 1 = most preferred strategy.

Table 2

Results of Treatment Acceptability Questionnaire Administered to Parents

Questions	Sam		Alice	Gina	Mean (Range)
	Mom	Mom	Dad	Mom	
Bedtime Pass	7	6	7	7	6.8 (6-7)
Time-based Visiting	7	4	7	6	6 (4-7)
Extinction	7	5	7	7	6.5 (5-7)

Note. Parents responded on a 7-point Likert scale: 7 = highly acceptable, highly satisfied, 1 = not acceptable, not satisfied.

Table 3

*Parents' Comments Regarding **Bedtime Pass** From Treatment Acceptability Questionnaire*

Sam (Mom)	Bedtime pass has worked well for us. It's giving him an opportunity to get something plus see us; he's used to being able to get water plus whatever else he needs. He looks forward to getting his pass then heading back to bed. We've experienced in the past few weeks some negotiation after getting back in bed but not too bad.
Sam (Dad)	The bedtime pass gave Sam a voice in his bedtime routine. I liked that. My only dislike was trying to remember if I should put him in his bed and say goodnight before I used the pass. So I guess I wasn't clear on the instructions. I would say this was more due to my somewhat inconsistent involvement though, not being at each meeting with Sandy.
Alice (Mom)	I liked the fact that she learned that given the pass, she learned to use for what she wanted instead of crying & once she received her request she was satisfied and promptly thereafter fell asleep. I was content I could go in give request and be able to come back in one last moment. She would fall asleep content.
Gina (Mom)	Gina really enjoyed this pass. I think she felt like she had some control of her situation, in terms of coming to see me if she wanted to. I liked the pass b/c it was so easy to implement b/c she enjoyed it from the start. I also liked how quickly she understood the "power" of the pass & felt comfort by just having it near her at night (even if she didn't use it).

Table 4

*Parents' Comments Regarding **Time-based Visiting** From Treatment Acceptability Questionnaire*

Sam (Mom)	This also worked well for us. I liked being able to go + check on him but sometimes feared that he would start to negotiate with me once I came in to check on him. This never happened too often though. He ultimately chose the bedtime pass but I would have liked to implement this more often, but he's made a choice that he enjoys.
Sam (Dad)	I think the bedtime pass worked very well for Sam. I think time based visiting work ok, but I am not sure that it made as much sense to Sam given the fact that we would come in at times based on a clock and not his actual needs.
Alice (Mom)	I didn't like this as much but I saw how it made sleeping easier for her knowing that mom would be coming in often to "check in" on her. I took time for me to go in and every few & remain there it was a trying time. Although at the end of this I too felt contentment knowing she was falling asleep with ease of having mom near.
Gina (Mom)	This took a little getting used to only b/c Gina always seemed to beat me to visit. Once I got the hang of it, it went well, although it's still hard to ignore the grabbing for hugs, or bids for interaction. I didn't hate this treatment, but compared to the others it was my least favorite. Checking in seems like it was redundant at such close intervals once we established the routine. At times, Gina seemed to find it funny that I was coming in so often. I do have to say that it got easier and better over time for both of us and at this point she falls asleep before the 30 minute mark.

Table 5

*Parents' Comments Regarding **Extinction** From Treatment Acceptability Questionnaire*

Sam (Mom)	I was initially apprehensive about extinction, not knowing how upset he would be or for how long… It turned out to not be so bad. I didn't like walking away from him crying but it didn't last long."
Sam (Dad)	I liked extinction due to its simplicity. It also worked fairly well. I don't think Sam liked it as much due to its abruptness, which could sometimes make it more difficult for us.
Alice (Mom)	I like this because it was no work at all to just prep for bed, goodnight and lights out. Easy for mom, but my only dislike that it didn't work well for her and I had to hear the crying out and screaming
Gina (Mom)	This was both easy and difficult. Initially, it was hard to just walk out of the room b/c Gina didn't really understand the "rules". We did a lot of explicit discussion the next day to explain why we were doing things, the rules of each treatment and what she needed to do. This helped us both during extinction nights--less guilt on my part knowing that she understood that I love her, but we just can't talk at bedtime.

Table 6

Questions and Results of Social Acceptability Questionnaire Administered to Parents

Questions	Ratings		
	Sam	Alice	Gina
1. Rate the extent to which you found the assessment procedures (interview, baseline period, multiple measures) acceptable.	7	7	7
2. Rate the extent to which you found the recommended treatment package acceptable.	7	7	7
3. Rate the extent to which you are satisfied with the amount of improvement seen in your child's sleep.	7	7	7
4. Rate the extent to which you found the sleep consultation provided by our team helpful.	7	7	7

Note. Parents responded on a 7-point Likert scale: 7 = highly acceptable, highly satisfied, very helpful, 1 = not acceptable, not satisfied, not helpful.

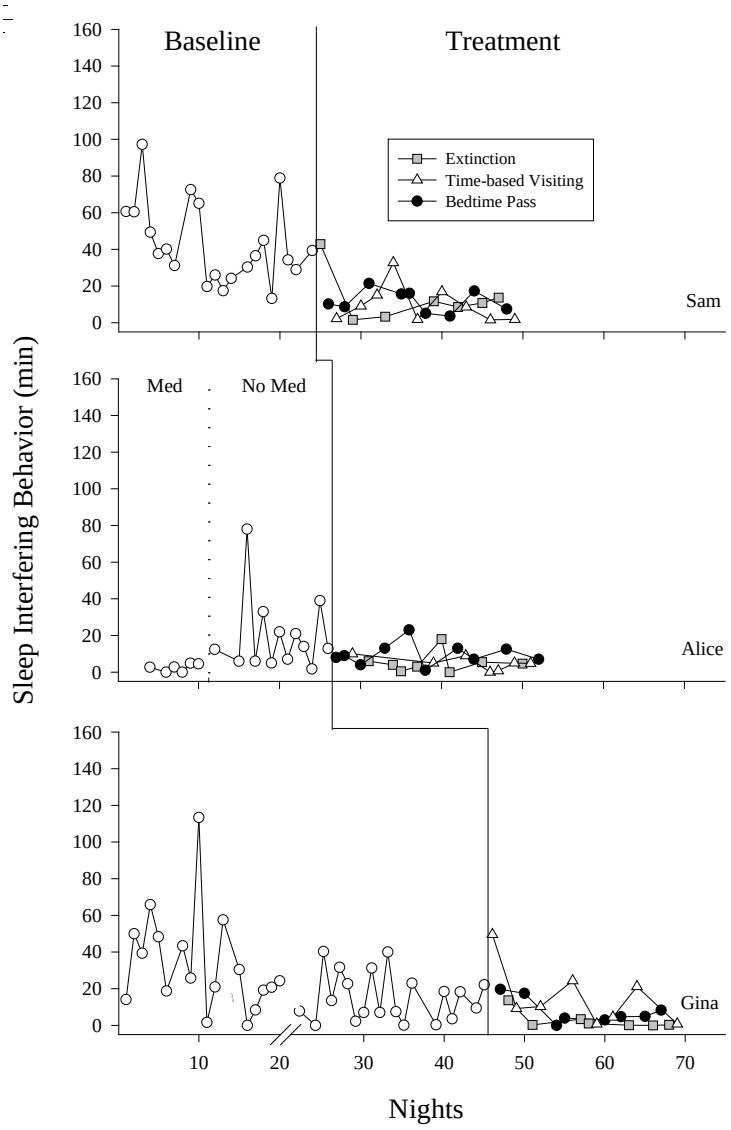

Figure 1. This figure depicts the duration of sleep interfering behavior (min) across three children measured from video recordings. Alice was given 3 mg of melatonin, 0.1 mg of clonidine, and 4 ml of hydroxyzine in a portion of the baseline condition.

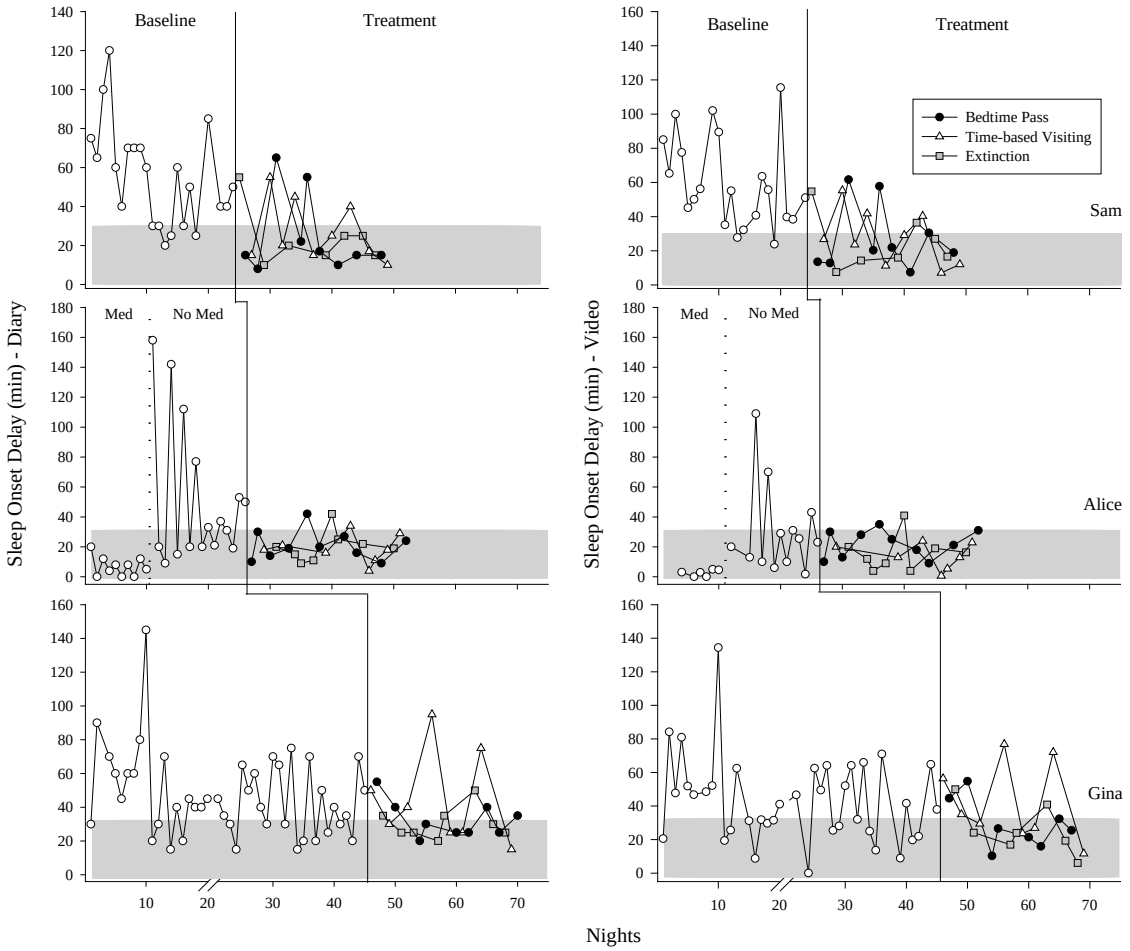

Figure 2. Sleep onset delay (min) across three children in the study are depicted on this figure. The horizontal bar represents appropriate range of sleep onset delay (30 min).

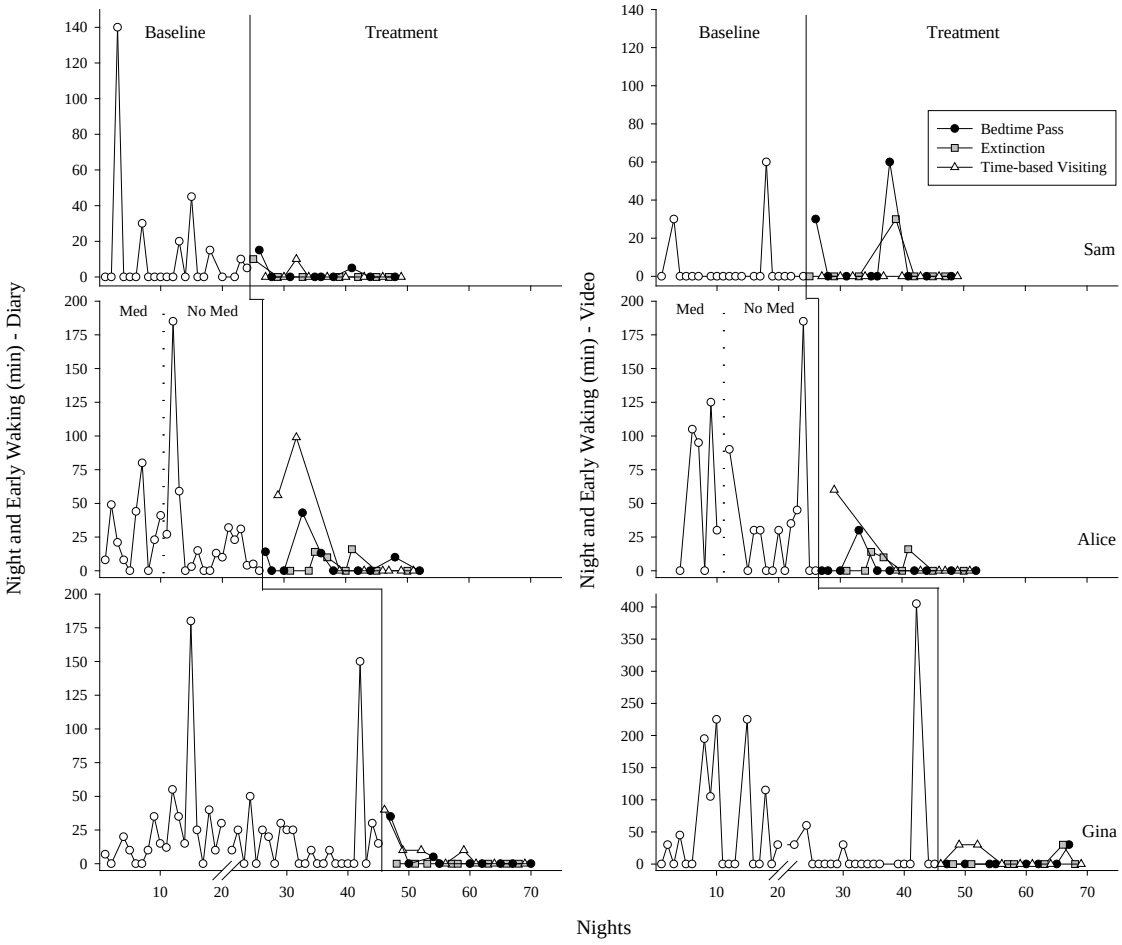

Figure 3. This figure depicts the duration of night and early wakings.

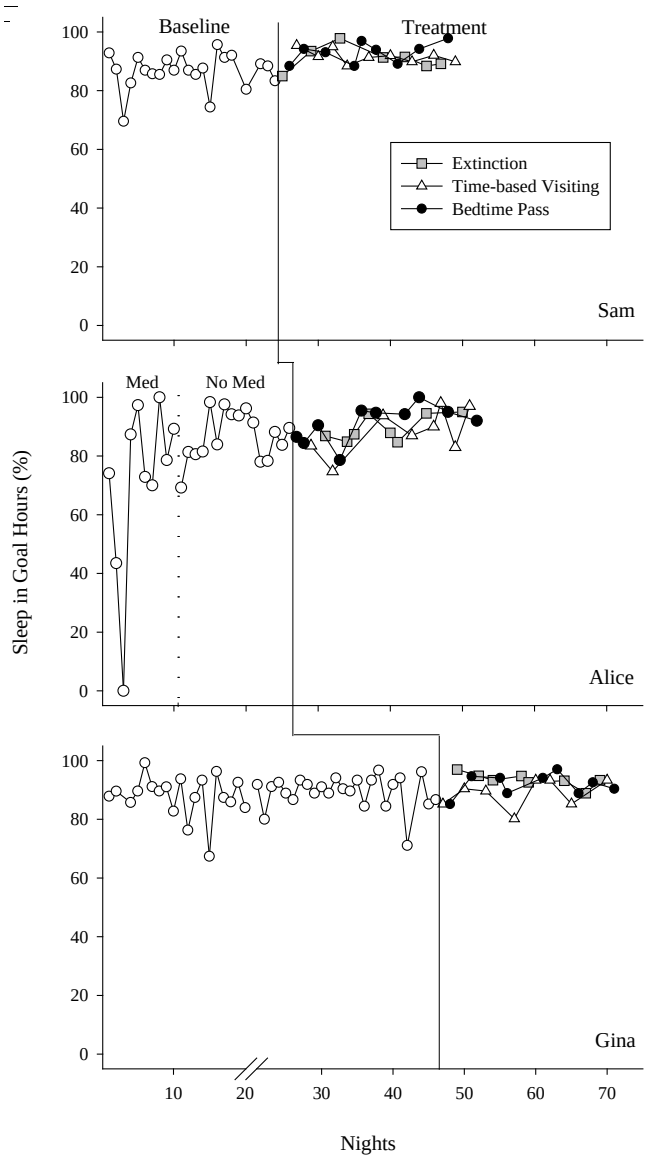

Figure 4. This figure depicts the percentage of sleep during goal hours across three children.

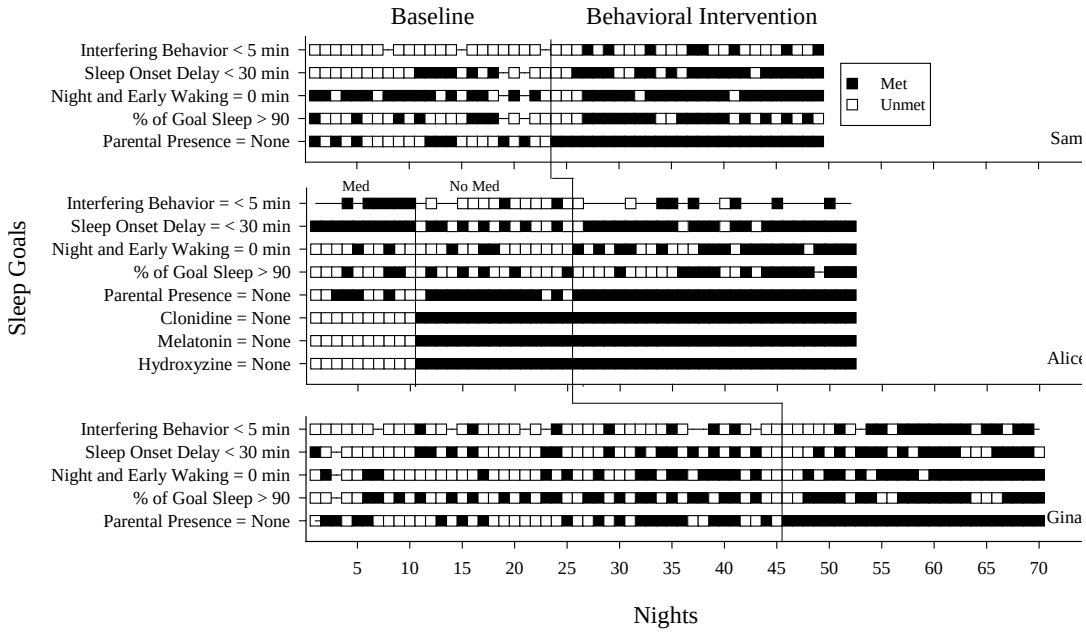

Figure 5. This figure depicts whether the sleep goals were met across different dependent measures for each child in the study. Filled squares represent nights during which a particular sleep goal was met whereas open squares represent nights during which a particular sleep goal was not met. Depicted measures for all three children include interfering behavior, sleep onset delay, night and early wakings, and % of goal sleep. Additional measures represented for Alice include whether clonidine, melatonin, and hyroxyzine was given.

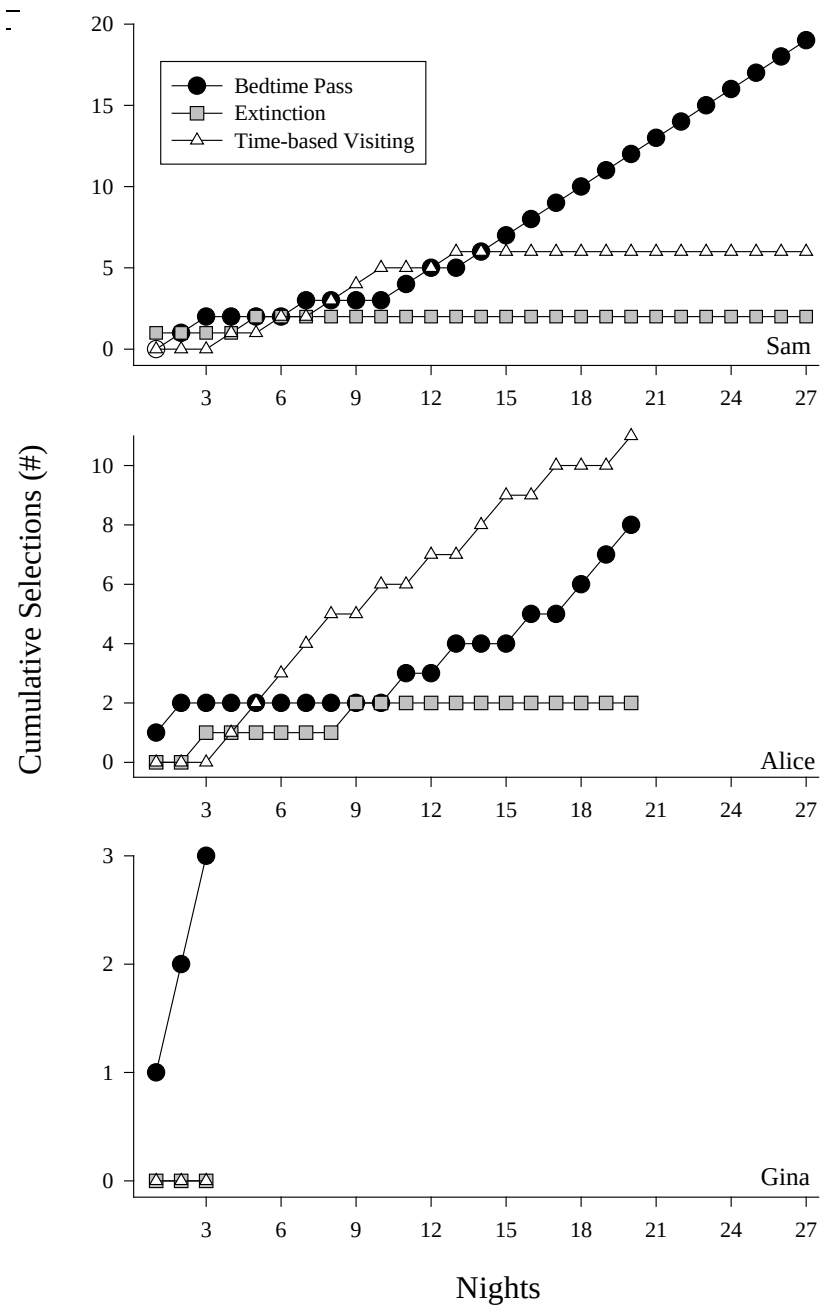

Figure 6. This figure depicts each child's cumulative initial-link selections across three different treatment conditions.

Appendix A

Sections from the Sleep Diary

Instruction: Please use an up arrow ↑ to indicate time of awake, a down arrow ↓ to indicate time fell asleep, an * to indicate when you bid the child goodnight, and write down the specific times below these symbols. Shade in the region when your child is asleep.

	P.M.						A.M.												P.M.					
Date	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**

1. Please indicate the location of any daytime naps.

2. Please document any bedtime routine instructions you gave your child and whether you child complied with those instructions. If your child did not follow instructions, describe any problem behaviors they engaged in, and how many times or how long these behaviors occurred. Please also describe how you responded to these behaviors.

3. Please describe any incompatible or interfering behaviors your child engaged in after you bid them goodnight and how many times or how long interfering behavior occurred (e.g., watching TV, eating snacks, playing with toys, crying, or tantrum). Please also describe how you responded to those behaviors.

4. If your child did not sleep in their own bed (e.g., fell asleep on the couch or in the living room) or if your child was unable to fall asleep independently, please describe and indicate the amount of time spent sleeping out of bed or sleeping in bed, but not alone.

5. Please describe any problems behavior during night waking or early waking (e.g., calling out, crying) and how many times or how long your child engaged in these behaviors. Please also describe how you responded to problem behaviors.

6. Please describe anything else you observed that may contribute to your child's sleep problems.

Appendix B

Treatment Questionnaire for Parents

1. Rate the extent to which you found using bedtime pass acceptable to address your child's sleep interfering behaviors (crying, call outs, getting out of bed, making requests etc…), and the time it takes for your child to fall asleep.

   1 2 3 4 5 6 7

   Not Acceptable Highly Acceptable

What were your likes and dislikes?
Please provide other additional comments:

2. Rate the extent to which you found using time-based visiting acceptable to address yout child's sleep interfering behaviors (crying, call outs, getting out of bed, making requests etc...), and the time it takes for your child to fall asleep.

   1 2 3 4 5 6 7

   Not Acceptable Highly Acceptable

What were your likes and dislikes?
Please provide other additional comments:

3. Rate the extent to which you found using extinction acceptable to address you're your child's sleep interfering behaviors (crying, call outs, getting out of bed, making requests etc…), and the time it takes for your child to fall asleep.

   1 2 3 4 5 6 7

   Not Acceptable Highly Acceptable

What were your likes and dislikes?
Please provide other additional comments:

4. Please rank the following strategies based on your preference, with 1 being the most preferred strategy and 3 being the least preferred strategy.

   ___ Time-Based Visiting
   ___ Extinction
   ___ Bedtime-Pass

Please elaborate on your reason(s) for this preference:

5. Rate the extent to which you are satisfied with the amount of improvement seen in your child's sleep *with your most preferred strategy*.

   1 2 3 4 5 6 7

   Not Satisfied Highly Satisfied

Please comment:

Appendix C

Final Questionnaire for Parents

1. Rate the extent to which you found the assessment procedures (interview, baseline period, multiple measures) acceptable.

1 2 3 4 5 6 7

Not Acceptable Highly Acceptable

Please comment:

2. Rate the extent to which you found the treatment package acceptable.

1 2 3 4 5 6 7

Not Acceptable Highly Acceptable

Please comment:

3. Rate the extent to which you are satisfied with the amount of improvement seen in your child's sleep.

1 2 3 4 5 6 7

Not Satisfied Highly Satisfied

Please comment:

4. Rate the extent to which you found the sleep consultation provided by our team helpful

1 2 3 4 5 6 7

Not Helpful Very Helpful

Please comment:

5. Please provide any additional comment you may have for our team.