REDUCING NIGHTTIME WAKEFULNESS IN CHILDREN WITH AUTISM: A TREATMENT PACKAGE APPROACH

Karina M. Koenig

A thesis submitted in partial fulfillment of
the requirements for the degree of
Master of Arts

Department of Psychology

Central Michigan University
Mount Pleasant, Michigan
August 2013

This is dedicated to my family
for their love, support, and understanding
throughout this project.

ACKNOWLEDGMENTS

I would like to thank the members of the Thesis Committee: Dr. Carl Johnson, Dr. Sharon Bradley-Johnson, and Dr. Sandra Morgan for sharing their knowledge with the graduate students in their department and for the valuable direction, support, and contributions they provided to this project. I would especially like to thank Dr. Carl Johnson for his work reviewing drafts of both the thesis prospectus and the thesis. In addition, I extend gratitude to the staff at the Sonya Ansari Center for Autism for help in recruiting participants and to the families who participated in this research study for their valuable efforts and patience.

ABSTRACT

REDUCING NIGHTTIME WAKEFULNESS IN CHILDREN WITH AUTISM:
A TREATMENT PACKAGE APPROACH

by Karina M. Koenig

An empirically-supported, non-invasive, and parent-approved sleep treatment package was applied to reduce settling difficulties and night wakings in children with autism spectrum disorders (ASD). Participants included 6 families with children that ranged in age from 3- to 6-years-old. The treatment package included circadian rhythm management (CRM), positive bedtime routines (PBR), limit setting by parents, and 40-60 dB white noise played continuously throughout the night. After intervention, a follow-up was conducted that included an additional week of sleep diary data and a treatment satisfaction survey.

A non-concurrent multiple baseline across participants design was used to analyze the effectiveness of the treatment package. Data were graphed based on the three dependent variables: duration of settling at bedtime, frequency of night wakings, and duration of night wakings. Four of the 6 participants had both night waking and settling difficulties. A reduction in length of settling was found during treatment for the 4 children with settling difficulties. Follow-up data showed that settling time increased from treatment levels for 3 of these 4 children. Two of these 3 had settling times that were still below pre-treatment levels. The third child went back to pre-treatment levels; however, he still showed a reduction in night waking frequency and duration. The fourth child showed further reduction in settling time from treatment to follow-up. Frequencies of night wakings were reduced during treatment for 2 of the 5 children with night waking difficulties. Four of these children showed a reduction in night waking frequencies by follow-up. Four of these children showed a decrease in the duration of night wakings during treatment. The fifth child also showed a decrease in duration and

frequency when data with special circumstances were removed. During follow-up, all 5 children with night waking difficulties showed further reductions in duration of night wakings. Follow-up data indicated less fragmented sleep patterns for all participants.

All parents reported satisfaction with treatment results, indicated that administering the treatment package was within their skill level, and thought the treatment was worth the effort.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

FIGURES PAGE

CHAPTER I

INTRODUCTION

Types of Sleep Disorders

There are over 80 kinds of sleep disorders, which are commonly classified as either parasomnias or dyssomnias (Schreck & Mulick, 2000; Wiggs & Stores, 2004). Parasomnias involve difficulties with arousal, partial arousal, and irregular transitions from one sleep stage to another. Dyssomnias include difficulties in falling asleep, staying asleep, or being overly tired (Schreck, & Mulick, 2000; Wiggs & Stores, 2004). Anywhere from 15-50% of children worldwide have been cited to develop sleep difficulties within the first four years of their life (Donaldson & Owens, 2006; Owens, 2004; Sakakini, 2011). In school age children, anywhere from 25-50% show sleep difficulties (Bates, Viken, Alexander, Beyers, & Stockton, 2002; Owens, 2004; Sakakini, 2011).

Although there are a multitude of sleep disturbance problems, Richman (1981) found wakefulness to be the most common problem among young children. Wakefulness includes settling (difficulty falling asleep at bedtime) as well as night waking. Settling difficulties may be a result of lack of specific bedtime routines or ineffective routines (Richdale, 1999). Parents sometimes give in to a child's maladaptive behavior which may interfere with their child getting to bed at an appropriate time, and maladaptive bedtime routines can distort a child's sleep cycle (Souders et al., 2009).

Night wakings affect approximately 30% or more of all children between infancy and preschool (Richdale, 1999). Parents viewed night wakings as problematic due to high frequency of occurrence, the need for parental intervention, and length of time spent putting children back

to bed (Meltzer & Mindel, 2006). Some researchers consider night wakings to be a problem if the child wakes 3-5 nights a week and if the parent feels the wakings are a disruption (Lozoff & Zuckerman, 1988; Richman, 1981). However, Sakakini (2011) stated that sleep difficulties are defined in a variety of ways with no true universal definition. He cited Owens (2004) who identified sleep problems as those which interfere with obtaining and maintaining normal sleep, occur chronically or frequently, and affect daytime functioning (Sakakini, 2011).

Autism and Sleep Disorders

Prior to the *Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition* (DSM-V, 2013), Autism was commonly considered part of a broad class of disorders, collectively referred to as Pervasive Developmental Disorders (PDD). These included: Autism, Asperger's Disorder, Rett Syndrome, Childhood Disintegrative Disorder and PDD Not Otherwise Specified (PDD-NOS). Autism, Asperger's, and PDD-NOS were sub-grouped into the category of Autistic Spectrum Disorders (ASD) (Richdale, 1999). PDD disorders were often characterized by difficulties with socialization, communication, and stereotypic behaviors (Lovaas et al., 1973; Moon, Corkum, & Smith, 2011; Richdale, 1999). Publication of the DSM-V redefined these disorders as falling under the category of Autism Spectrum Disorder no longer qualifying them as their own categories, but simply disorders that fall along the autism spectrum (American Psychiatric Association [APA], 2013).

Children with Autism Spectrum Disorders (ASD) have been found to have disrupted sleep routines (APA, 2013; Moon et al., 2011; Richdale, 1999). Studies show 40 to 83% of children with ASD experience sleep difficulties (Giannotti, Cortesi, Cerquiglini, & Bernabei,

2006; Hare, Jone, & Evershed, 2006a; Richdale, 1999; Schreck & Mulick 2000; Souders, et al., 2009; Tudor, Hoffman, & Sweeney, 2012).

Schreck, Mulick, and Smith (2004) found that hours of sleep were negatively correlated with overall autism scores. Additionally, some research suggests that there is a correlation between shorter hours of sleep obtained and increased stereotyped behaviors, communication difficulties, and social difficulties for children along the autism spectrum (Tudor et al., 2012). Polimeni, Richdale, and Francis (2005) noted that over 60% of parents of children with autism reported disrupted sleep patterns in their children and themselves. Parents report irregular sleep-wake cycles with long night wakings, resulting in reduced sleep in their children with ASD. Dyssomnia disorders have been cited to occur more often in children with ASD compared to their typically developing peers (Tudor et al., 2012). According to Mayes and Calhoun (2009), the majority of children with ASD appear to have sleep difficulties (Moon et al., 2011).

There are possible biological and behavioral causes for sleep disturbances in autistic individuals. Potential causes for these disruptions include irregular serotonin and melatonin release, the inability to decode social cues that serve as zeitgebers (time cues), behavior disorders, and communication problems (Glickman, 2010; Richdale, 1999). Functional magnetic resonance imaging (fMRI) studies have shown that children with autism have impairments in the amygdala, an area for perceiving other's emotions. This brain abnormality is linked to ASD children's difficulty perceiving the emotions of others, decoding social cues, and reciprocating social interactions (Hall, West, & Szatmari, 2007). How this might relate to sleep problems is not clear because the research is limited, but there seems to be a consensus that children with autism experience more sleep disturbances than the general population (Richdale, 1999; Schreck & Mulick, 2000; Tudor et al., 2012; Wiggs & Stores, 2004).

Because it is unclear whether neurological, behavioral, social, sensory stimulation factors or some combination are the underlying cause for sleep difficulties in children with autism and, moreover, due to the heterogeneous nature of children exhibiting ASD, an intervention that works for one autistic child may not work well for another. Thus, an intervention package would appear to be helpful in discovering an approach to reduce dyssomnias. Weiskop, Richdale, and Mathews (2005) found that the use of positive bedtime routines in a treatment package approach reduced settling problems, co-sleeping, and night waking in children with ASD and Fragile X syndrome (Moon et al., 2011). Circadian rhythm management, positive bedtime routines, and white noise are interventions that have been found to be useful in increasing compliance and reducing night waking in typically developing children (Adams & Rickert, 1989; Forquer & Johnson, 2005; Mindell et al., 2006; Piazza, Hagopian, Hughes & Fisher 1998; Weissbluth, 1982). Another component that researchers have cited as an important part of overall good sleep hygiene is limit setting (Ferber, 2006; Lecuyer & Houck, 2006; Souders et-al, 2009; Vriend, Corkum, Moon, & Smith, 2011). For this reason, these four interventions may be useful in an intervention package geared toward ameliorating sleep difficulties in children with autism.

Literature Review

Various methods have been used to decrease sleep disturbances in typically developing children. As noted in a review by Mindell (1999), behavioral techniques such as extinction, graduated extinction, and scheduled awakenings have reduced sleep disturbances. Additionally, medication and hormones such as melatonin have been used. However, medications were found to be less acceptable to parents, to be less effective than behavioral techniques, and to have

unpredictable side effects (Mindell, 1999; Ramchandani, Wiggs, Webb, & Stores, 2000; Richdale, 1999; Sajith & Clarke, 2007, Sakakini, 2011).

Although behavioral techniques appear to be more effective and longer lasting, they are often difficult for parents to employ consistently (Kuhn & Weidinger, 2000; Mindell, 1999). Owens, France, and Wiggs (1999) stated, "No evidence of deleterious effects was found in these studies but, given the concerns expressed by parents and professionals alike, the development of modifications and alternatives to unmodified extinction, which are empirically demonstrated to reduce infant distress, is desirable." This statement suggests that although extinction works, there may be more socially acceptable means of reducing sleep difficulties. According to Lawton, France, and Blampied (1991), post-extinction response bursts were found in children who had experienced the graduated extinction procedure, which the researchers surmised may have been the result of a high level of sensitivity toward the conditions imposed or the shift in parental attention. Unfortunately, not enough research exists for many of these techniques used for sleep disorders in children with autism.

Due to the difficulties that some of these approaches can pose for both parents and their children, it is important to examine viable alternatives such as circadian rhythm management (CRM), positive bedtime routines, limit setting, and white noise. Considering that children with autism are typically described as having sensory difficulties (Lovaas et al., 1973), any approaches tried should be limited in regard to physical invasiveness. Additionally, any treatment administered to children should be acceptable to the parents. White noise, positive bedtime routines, and CRM have all been reported as acceptable sleep interventions by parents of typically developing preschoolers (Adams & Rickert, 1989; Johnson, 1991).

Circadian Rhythms

Circadian rhythms play an important role in our sleep-wake cycle, hormonal balance, behavior, and sexual reproduction cycles. They are an important part of the biological and behavioral function of an organism and must remain in a state of homeostasis for the body to function properly throughout the day. Circadian rhythms are usually slightly longer than 24 hours and are maintained by zeitgebers (Fuller, Gooley & Saper, 2006; Glickman, 2010). Zeitgebers are external cues that are responsible for resetting the biological clock that controls circadian rhythms (Fuller et al., 2006). One of the most effective zeitgebers is illumination, especially the sunrise and sunset of each day (Ferber, 2006). Social cues and daily routines can act as zeitgebers such as eating breakfast at the same time every day. Repetitiveness of a sleep, meal, and nap schedule will help to regulate a child's circadian rhythms (Ferber, 2006).

Children with autism are theorized to have disrupted sleep and circadian rhythms (Glickman, 2010; Stores & Wiggs, 1998). Glickman (2010) reported that indications of circadian rhythm disorders include inability to sleep during desired hours, difficulty falling asleep, difficulty maintaining sleep, and early waking. He reported that these are the most commonly seen sleep problems in children with autism (Glickman, 2010). Hare, Jones, and Evershed (2006a) found lower amplitude circadian rhythms in 10 adult males on the autism spectrum. The lower circadian rhythms were found to be strongly linked to environmental synchronizers. Children with autism have a hard time decoding social cues due to over selective attention. Several studies found that when presented with a multifaceted stimulus, they select one aspect of the stimulus to attend to, ignoring the rest (Lovaas & Wilhelm, 1976; Rincover, 1978; Schreibman, 1975). This problem has caused difficulty for children with autism in the areas of learning and social functioning. Thus, a daily routine such as interacting with someone

at breakfast could serve as a social cue and a zeitgeber, but a child with ASD might miss these cues.

Research is sparse in the area of CRM as a sleep intervention. Czeisler (1980) reported that CRM effectively treated delayed sleep-phase insomnia in adults. Weissbluth (1982) was able to successfully reduce night wakings in a 7-month-old girl. This child was reported to have a low sensory threshold on the *Carey Infant Temperature Questionnaire*. For the intervention, the infant's schedule was maintained at a set time for waking (7am) and napping (11am). This CRM procedure improved her sleep patterns. Many children with autism also have low sensory thresholds, and therefore CRM may be useful for children with ASD.

However, the potential of CRM alone to improve sleep for children with ASD may be limited. CRM coupled with positive bedtime routines was an effective treatment for sleep difficulties in an 8-year-old with autism (Piazza et al., 1998). Chronotherapy was used to systematically delay her bedtime, while at the same time regular daytime hours and activities were maintained. This intervention served to re-regulate her natural CRM cycle. She experienced reductions in the number of night wakings, early morning wakings, and the amount of time she took to fall asleep. She also experienced an increase in her overall sleep duration. In another study using chronotherapy, Dahl, Pelham, and Wierson (1991) used positive behavioral routines in conjunction with CRM (slowly adjusting the bedtime and rising time) of a 10-year-old girl with attention deficit disorder (ADD). Results showed an increase in time spent sleeping per night, academic performance, and positive peer relations. Published research beyond these two studies is limited, thus CRM may have potential but empirical support is not strong at this time.

Positive Bedtime Routine

A positive bedtime routine (PBR) involves choosing 4-6 routines each night which are implemented ritually 7 nights a week. For each bedtime activity that is completed, the child receives praise. Each activity serves as the stimulus control for the next activity, and the last activity signals that it is time to go to sleep. According to Blampied and France (1993), "If sleep is to occur reliably and appropriately, the operant chain of preparing for and falling asleep needs to come under the control of appropriate discriminative stimuli (S^D)." Additionally, they reported that positive bedtime routines are acceptable to parents and as effective as other behavioral techniques such as extinction and graduated extinction. Adams and Rickert (1989) found that positive bedtime routines worked quickly to reduce tantrums, increase compliance, and reduce family stress in typically developing preschoolers. Moreover, PBR worked faster than graduated extinction. In another study, positive bedtime routines were effective in increasing cooperation, reducing sleep latency, and reducing tantrums in three children with developmental delays (Milan, Mitchell, Berger, & Pierson, 1981).

Schreck (2001) noted that although no interventions using strictly bedtime routines have been employed for children with autism, a few studies found success in combining positive bedtime routines with other interventions. Christodulu and Durand (2004) used positive bedtime routines and sleep restriction as intervention for four children with developmental delays. One child was previously diagnosed as having PPD-NOS and another was diagnosed with autism. The researchers found that the combination of positive bedtime routines and sleep restriction increased nighttime cooperation, decreased night waking, and increased parental satisfaction with bedtime experiences. Weiskop, Richdale, and Mathews (2005) used a treatment package approach that included bedtime routines, parent instruction, extinction, partner support, and

reinforcement to reduce settling problems, night wakings, and co-sleeping in 13 children. Of these children, 6 were diagnosed with an ASD and 7 were diagnosed with Fragile X syndrome (Weiskop et al., 2005). In 2004, Moore found a treatment package that included reinforcement, graduated extinction, bedtime routines, and social stories to be effective in reducing settling and co-sleeping difficulties for one 4-year-old child with ASD (Vriend et al., 2011). In summary, positive bedtime routines in conjunction with other behavioral approaches seem to have empirical support for treating bedtime struggles for children with autism. However, this technique is not designed to ameliorate night waking difficulties.

Limit Setting

According to Ferber (2006) appropriate limit setting can reduce co-sleeping, sleep association problems, and bedtime behavior difficulties. Limit setting can include, but is not limited to, things such as incorporating a drink into the bedtime routine (rather than letting the child ask for one), restricting the amount of electronics before bed, or abstaining from co-sleeping. Ferber's limit setting guidelines include reinforcement to increase desired behaviors and decrease undesired behaviors (Ferber 2006; Vriend et al., 2011).

A study of 60 families compared sleep problems among children with ASD to sleep problems of typically developing children and found that 15% of the children with ASD were diagnosed with behavioral insomnia due to limit setting difficulties (Souders et al., 2009). Although the families had tried to establish a bedtime routine, they were unable to do so because of lack of limit setting. The study found that 45% of the typically developing children had mild sleep difficulties, whereas 66% of the children with ASD had moderate sleep difficulties (Souders et al., 2009).

Additionally, improper limit setting can affect good sleep hygiene (habits that are conducive to good sleep) and may affect daytime behavior in typically developing children and children with autism (Ferber, 2006; Lecuyer & Houck, 2006; Souders et-al, 2009; Vriend et al., 2011). Vriend et al (2011) discussed sleep hygiene for children with ASD and stated, "Since parents are involved in setting limits around children's sleep and sleep habits, parent education is crucial." This suggests that some researchers feel that with parent involvement, proper limit setting could be an important part in sleep routines for children with autism. Vriend et al (2011) completed a meta-analysis of current behavioral interventions used to reduce bedtime difficulties in children with autism and found 3 studies that used limit setting as a part of sleep hygiene with some success. Two of these studies showed a decrease in problem behaviors during daytime as well (Vriend et al., 2011).

White Noise

Another sleep intervention found to be effective with typically developing children is use of white noise. White noise covers the entire human hearing range (20-20,000 Hertz) and has been found to increase ability to fall asleep as well as decrease night wakings. Forquer (2006) and Forquer and Johnson (2007) found this effect in college students exposed to 50-75 decibels (dB) of white noise during their sleeping hours. In addition, white noise generators set at 75 dB were effective in reducing bedtime resistance, night wakings, and parental stress in toddlers (Forquer & Johnson, 2005). Coupling white noise with positive bedtime routines was effective in increasing toddler's ability to fall asleep and stay asleep (Borkowski, Hunter, & Johnson, 2001). These four studies found the use of 50-75 dBs to be effective and safe in reducing night time difficulties.

The current study employed the use of slightly lower decibels of 40-60 because they have been shown to be within the safe sound range, and children with autism may have more sensitivity to physical stimulation, such as sound.

Studies have found additional benefits relating to better sleep and reduced physical arousal with the use of white noise. Brackbill (1970) found that the respiratory rate of normally developing infants exposed to white noise was regular and the children exhibited decreased arousal. These infants also slept 75% longer than infants who were exposed only to typical room noises. Moreover, some research indicates that white noise can reduce heart rate and motor activity (Schmidt, 1975). In 1971, Brackbill studied the effects of continuous verses intermittent noise stimulation on 27-month-old infants. Sound was one of the four modalities that she employed to decrease arousal. The other three were movement, vision, and temperature. Her results indicated that the more modalities that were used the more arousal decreased. She further explored these findings by employing all four modalities for two hours. A decrease in heart rate, respiration, and motor activity was found. In a study that utilized 40 neonates, five minutes of continuous heart beating sounds were played. The sounds ranged from 67-72.5 dB. The results indicated that the neonates who were exposed to the heart beat sounds fell asleep quicker than those who were not (Spencer, Moran, Lee, & Talbert, 1990). White noise was also found useful with patients who had just gone through coronary artery bypass surgery indicated by reports of improved night's sleep (Williamson, 1992). These studies suggest that along with reducing sleep difficulties, white noise may decrease arousal and motor activity, and regulate respiration and heart rate.

In a survey by Johnson (1991), parents reported the use of white noise as an acceptable approach to intervene with children's sleep difficulties. Additionally, the use of white noise in

some homes may happen inadvertently such as when fans and humidifiers are used (Johnson, 1991). At this time, the efficacy of white noise to reduce sleep latency in children with autism is unknown.

Problem Statement

Why is lack of sleep such a difficult problem and what are the implications of sleep deprivation? Research has found that receiving less than seven hours of total sleep and short sleep duration can cause Chronic Partial Sleep Deprivation (CPSD). CPSD can result in difficulties which include negative mood, decreased attention, reduced working memory, elevated stress, reduced tolerance to glucose, and fatigue. Accumulation of partial sleep loss may also result in cognitive dysfunction after 1-3 days of total loss of sleep (Banks & Dinges, 2007; Meltzer, 2008; Sadeh, Raviv, & Guber, 2003).

Symptoms of CPSD have been found in children with autism and their parents due to shorter sleep durations (Meltzer, 2008; Goldman, Richdale, Clemons & Malow, 2012). A difference in the quality and quantity of sleep that parents of children with autism receive compared to parents of typically developing children has been found as well. There are some studies that support chronic sleep deprivation in children with autism is related to more behavioral difficulties during the day, which in turn could affect ability to complete academic tasks (Moon et al., 2011). This indicates that the parents of children with autism and the children themselves would benefit from a reduction in CPSD.

Those with CPSD have been found to have slower cognitive processing and reacting time. A study by Sadeh et al. (2003) supported previous research that fragmented or insufficient sleep can affect typically developing children's alertness and neurobehavioral functioning, even

with modest alterations in the duration of sleep. The children in this study ranged in age from 9-12 years old, which is an age range that would require less sleep than the ages within the current study. It should also be noted that in a longitudinal study, younger children with ASD showed difficulties with fragmented sleep (Goldman et al., 2012). Actigraphy, which involves attaching a movement device to the participants' wrists, was used to monitor the sleep-wake patterns. To evaluate neurobehavioral functioning, they completed computer tests that included finger tapping (tapping as fast as they could), reaction time (pressing a button as quickly as possible when a square appeared), a continuous performance test (responding quickly to one stimulus and not others), symbol-digit substitution (correctly choosing digits for symbols they were previously paired with), and recalling a sequence of digits. Results showed that ability to recall a sequence of digits declined in participants with less sleep and increased in participants who had received 35 minutes more sleep. After baseline, reaction time increased (took longer) for all the participants regardless of the amount of sleep they obtained. However, it increased substantially for those with less sleep and only slightly for those with more sleep. The authors noted that this could be due to boredom with the recurring task but emphasized that the effect was larger for those with less sleep. Additionally, the participants who had more sleep showed significant improvement on the continuous performance test, but the participants with less sleep did not. Although sleep deprivation is a problem for any individual, less than 50% of children with a disability and a sleep disorder receive help, and when these children do receive help, it is often in the form of medication (Wiggs & Stores, 1996). This is important because behavioral interventions have longer lasting effects than medication (Ramchandani et al., 2000). Melatonin given directly prior to sleep has been shown to help resolve sleep problems in children with autism, but more studies regarding the efficacy and safety of its use with autistic children are

needed (Richdale, 1999; Sajith & Clarke, 2007). In addition, it has not yet been determined how pre-pubertal children metabolize melatonin. It is widely accepted that children with autism have difficulties with selective attention and increased sensitivity to physical sensations such as side effects from medications. Side effects associated with melatonin such as nightmares, stomach cramps, dizziness, headaches, and irritability may only further their intolerance to other environmental stimuli (Sajith & Clarke, 2007). Moreover, prescriptive medications may be stronger than melatonin, and the side effects of these sleep inducing drugs for children with autism are often unknown.

The majority of typically developing children who develop sleep problems continue to have these problems 3-5 years later (Kataria, Swanson, & Trevathan, 1987). Additionally, a study which evaluated sleep habits in 1,859 ASD children found that sleep difficulties continue to "persist" in adolescence (Goldman et al., 2012). This indicates that without remediation, the neurological and behavioral consequences associated with sleep deprivation may continue for quite some time, affecting both the child and the parents. This is a particularly salient problem for children with autism due to the behavioral and neurological difficulties they already experience (Goldman et al., 2012).

For this study, the four interventions of CRM, PBR, limit setting, and white noise were packaged together to evaluate their efficacy in ameliorating sleep difficulties in children with autism.

CHAPTER II

METHOD

Participants

Seven families with children between the ages of 3to 6-years-old that exhibited sleep problems and who were previously diagnosed with ASD participated in the study. Participants were recruited through the Sonya Ansari Center for Autism. The study was initially mentioned during a sleep and ASD presentation, and subsequently a flyer was placed in Sonya Ansari's weekly newsletter. Additionally, flyers were given to Midland County Educational Service Agency (MCESA), Wisconsin Early Autism Project (WEAP), Autism Alliance of Michigan, Autism Asperger Associates of Michigan, and Autism Society of Michigan (and its local subgroups). All participating families were recruited through the Sonya Ansari Center for Autism and, as mandated by the university's institutional review board (IRB), contacted the researcher to request participation in the study.

A number of factors were considered when selecting participants. Participants were selected based on parent reports and perceptions that their child had sleep difficulties with frequency and duration in bedtime settling, night wakings, or both. A night waking was classified as a waking in which parent intervention was required because the child could not self-soothe back to sleep. A settling problem was defined as taking more than 20 minutes to fall asleep 3 or more nights a week (Ferber, 2006; Lozoff & Zuckerman, 1988; Richman, 1981). Additionally, diagnostic evaluation reports, parent ratings on the *Gilliam Autism Rating Scale-Second Edition* (GARS-2), and parent ratings on a modified version of the *Infant and Toddler Sleep Questionnaire* (ISQ) (Morrell, 1999) were taken into account. All parents who contacted

the researcher were the mothers of the children with sleep difficulties. Any medications or co-morbid conditions that participants reported are listed below.

Child A was a 6-year-old boy who was evaluated at the age of 4 in the Indiana South Bend Public School System by a multi-disciplinary team. His evaluation report indicated that he fell under the classification of ASD and that he met the DSM-IV criteria for Asperger's Disorder. On the ISQ, his mother rated him to have *mild* sleep difficulties, and he received a severity score of 8. He received an Autism Index rating of 70 on the GARS-2, falling in the *possibly* range. It should be noted that his rater reported feeling that he was higher functioning. He was not taking melatonin or any other medications. He woke about 5 times per week on average. The durations of his night wakings ranged from 5 to 30 minutes. Child A did not have settling difficulties and co-slept with parents prior to treatment.

Child B was a 3-year-old male who received a psychological evaluation through the Developmental Pediatrics Department at Indiana University 9 months prior to the research. He was diagnosed with Autism. On the GARS-2, he was rated to have an Autism Index of 124, falling within the *very likely* range. He received a severity score of 20 on the ISQ with a mother rating of *mild* sleep issues. He was not taking melatonin. However, he was taking 7.5 ml of Omeprazole per day for reflux difficulties. Before treatment, he was waking about 4 to 5 nights a week. Night wakings were typically lengthy (about 60 minutes). He had settling problems 7 days a week. It took him approximately 61 minutes to fall asleep each night. Child B did not co-sleep with parents.

Child C was a 4-year-old male who was originally evaluated and classified as a child with autism by a school psychologist and multidisciplinary evaluation team at Penn-Harrison Madison Schools in Mishawaka, Indiana. In a follow-up evaluation, he was classified as a child

with autism spectrum disorder by a clinical psychologist and research team through the University of Michigan's Autism and Communication Disorders Center. On the GARS-2, Child C received an Autism Index rating of 68. Although this fell within the *unlikely* probability range, it should be noted that the rater indicated feeling that Child C was high functioning. Subsequent to child C's original assessment, he was re-evaluated by an additional agency who concurred with the results of the initial evaluation and classified him as a child with autism. On the ISQ, he was rated to have *moderate* sleep difficulties and received a severity score of 15. Child C received 1mg of melatonin per night prior to the study and continued with this throughout the study. Prior to treatment, he woke 4 to 5 times a week, typically 1 waking per night. Night wakings were 45 minutes on average, and he co-slept with parents.

Child D was a 6-year-old male classified as having a PDD-NOS by an evaluation team at Riley Child Development Center at Indiana University Hospital. Previous to this evaluation, Child D was assessed through South Bend Community Schools during his Kindergarten year and was found eligible for services under ASD. On the GARS-2, Child D was rated to have an Autism Index of 89, falling within the *very likely* range. On the ISQ, he was rated as having *severe* sleep difficulties and received a severity score of 10. Child D did not have night waking difficulties, but he did have settling difficulties. Prior to treatment, it took him an average of 33 minutes per night to fall asleep. His longest pre-treatment settling time was 2 hours and 15 minutes. Prior to the study, he was taking 2 ¼ ml of melatonin, which he continued. Child D co-slept with parents prior to treatment.

Child E was a 4-year-old female who was evaluated and diagnosed by a clinical neurologist at Indiana University's Riley's Hospital for Children. Child E had a concomitant medical diagnosis of Fragile X and Autism. She typically woke about once per night 3 to 5

nights a week. The duration of her night wakings were about 75 minutes on average. Additionally, she had settling problems about twice a week. She received an Autism Index rating of 104 on the GARS-2, which falls within the *very likely* range. On the ISQ, she received a sleep difficulty rating of *moderate* and a severity score of 12. Child E was taking 3 mg of melatonin throughout the study and 10 mg of Daytrana for 3.5 weeks during baseline. No other co-morbid disorders were reported by Child E's mother. She did not co-sleep with parents prior to or during the study.

Child F was a 6-year-old male classified as having an ASD at the age of 4. He was evaluated through Janet Weis Children's Hospital in Pennsylvania by the Director of Pediatric Subspecialties in Neurodevelopmental Pediatrics. Child F's mother reported a previous evaluation and classification of ASD from his local school system. However, this previous report was not provided to the researcher. On the GARS-2, he received an Autism Index of 124, falling in the *very likely* range. He was rated to have *moderate* sleeping difficulties on the ISQ and received a severity score of 10. Prior to treatment, he had settling problems five to six nights a week. On average, he woke 3 to 4 nights per week prior to a spontaneous recovery period during baseline. After the recovery period (but before treatment), he appeared to be waking about 3 nights per week again. Prior to the study, he received approximately 2mg of melatonin per night, which continued. Before treatment, Child F co-slept with parents.

Child G was a 3-year-old male who was waking approximately 8 to 9 times per week. He was diagnosed with autism by a pediatrician at Indiana University's Riley's Hospital for Children. The mother of Child G withdrew from the study prior to starting intervention due to illness.

Table 1. *Participant Information*

	Child A	Child B	Child C	Child D	Child E	Child F
Age in Years	6	3	4	6	4	6
Gender	Male	Male	Male	Male	Female	Male
GARS Score	70 (66-74)	124 (120-128)	68 (64-72)	89 (85-93)	104(100-108)	124(120-128)
Diagnosis/Classification	Asperger's	Autism	Autism Spectrum Disorder	Prevasive Developmental Disorder-Not Otherwise Specified (PDD-NOS)	Autism & Fragile-X	Autism Spectrum Disorder
ADOS	Yes	Yes	Yes	Yes	No (Nuerological Diagnosis)	No (Nuerological Diagnosis)
Sleep Problems	Night Wakings	Bedtime Settling; Night Wakings	Night Wakings	Bedtime Settling	Bedtime Settling ; Night Wakings	Bedtime Settling; Night Wakings
Co-Sleeping	Yes	No	Yes	Yes	No	Yes
Medications	None	Omeprazole (for reflux)	Melatonin	Melatonin	Melatonin & Daytrana	Melatonin

Materials

Apparatus

Four of the 6 participants used a Brookstone Tranquil Moments Plus white noise generator (Model #348516). Each Brookstone Tranquil Moments Plus machine emitted 6 different sounds: one of which was a simulation of white noise. The remaining two participants used a Conair Sound Therapy white noise generator (Model #SU1W). Each Conair Sound Therapy machine emitted 10 different sounds: one of which was a simulation of white noise. For the purpose of this study, the simulation of white noise setting was used and was set between 40 and 60 decibels (dB) sound pressure level. Decibel readings and calibrations were carried out with a portable decibel reader (Tenma® Sound Level Meter, model 72-935).

The Infant Sleep Questionnaire

The *Infant Sleep Questionnaire* (ISQ) is a 10-item scale that divides infants into a sleep problem or non-sleep problem group. The ISQ identifies sleep problems in three ways: Richman's criteria, mother's criteria, and a severity score (Morrell, 1999). The ISQ uses a modified version of Richman's criteria. Richman's criteria classifies sleep problems as a settling or waking problem that occurs more than 5 times a week and lasts for more than 2 months. Additionally, the infant must have at least one of the following symptoms: taking longer than 30 minutes to fall asleep, waking at least 3 times a night, waking for longer than 20 minutes a night, sleeping with parents due to being upset, or sleeplessness at least 3 times a week (Morrell, 1999). The ISQ has a 4 point scale that mothers use to classify their infant's sleep patterns as no problem, mild problem, moderate problem, or severe problem (Morrell, 1999). A severity score ranging from 0-38 is given by summing the ratings given to the questions 1, 2, 4, 5, 6, and 8. All three methods of classifying children into a sleep problem or non-sleep problem group have high specificity and sensitivity ranging from 89.5-96.7 (Morrell, 1999). The test re-test reliability is better for the mother's rating score (.93) and the severity score (.92) than for the Richman's criteria (.76). The mother's criteria with a cut off score of 6 (which includes mild cases) will be used (Morell, 1999).

The Gilliam Autism Rating Scale-Second Edition

The *Gilliam Autism Rating Scale-Second Edition* (GARS-2) has an overall Autism Index that is comprised of 3 subscales: Stereotyped Behaviors, Communication, and Social Interaction. The criteria for this measure were derived from the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition- Text Revision (2000) and the Autism Society of America (2003)

(Gilliam, 1995; Schreck et al., 2004). Each subscale has 14 items and is designed to be completed by a parent or caretaker of the child being evaluated. Although the manual indicates that it was standardized on individuals within the age range of 3-22 years old, age is not considered when obtaining a score because scores are based on how frequently behaviors are observed by the rater (Bradley-Johnson, 2007). The GARS-2 is norm referenced with the norm sample included an adequate number of children with autism. Test retest showed correlations ranging from .70-.90 on the subscales with the Communication subscale being the only one below .85 and an Autism Index correlation of .88 (Gilliam, 1995). Internal consistency ranged from .84-.88 on the subtests and .92 for the Autism Index. Sensitivity and specificity indexes were between .84-1.00, indicating that it has a good ability to distinguish those with autism from those without (Gilliam, 1995; Montgomery, Newton, & Smith, 2008).

Procedure

Flyers were given to Midland (MI) County Educational Service Agency (MCESA), Wisconsin Early Autism Project (WEAP), Autism Alliance of Michigan, Autism Asperger Associates of Michigan, Autism Society of Michigan, and the Sonya Ansari Center for Autism. The flyers included the researcher's contact information and a brief description of the study. Parents of 3 of the participants that attended a presentation on sleep problems at the Sonya Ansari Center for Autism in South Bend, Indiana initiated contact with the researcher and requested participation. The additional 4 participants heard about the study through word of mouth within their community or through a weekly newsletter published by the Sonya Ansari Center for Autism and contacted the researcher requesting participation. Weekly contacts were made with the participants through email and phone to answer questions and encourage

participation compliance. Four scheduled phone meetings with each participant occurred throughout the study.

The first phone call was set up to discuss parent concerns about their child's sleep problems and to discuss study participation. A brief overview of CRM, positive bedtime routine, limit setting, and white noise procedures were given and monetary compensation was discussed. The researcher explained that participants would receive $25 after 1 to 3 weeks completion of baseline, $50 upon completion of the treatment package, and $25 upon follow-up completion.

A second phone call occurred with 5 of the 7 participants (2 were unable to be reached) in which a modified version of the Infant Sleep Questionnaire (ISQ) was given over the phone (Morrell, 1999). The phone calls were prescheduled through email and the ISQ was read to the participants word-for-word. The additional 2 participants were contacted via email and asked to fill out the survey and send it back as an email attachment.

Based on the data obtained from the modified ISQ survey, parents of participants who qualified were asked if they would like to continue participation. If the child met the study criteria, if the parents agreed to implement the treatment package consistently seven days a week, and if parents wanted to continue participation they were mailed a parent consent form to sign and a *Gilliam Autism Rating-Second Edition* (GARS-2) to complete. To qualify for the study, a child's inability to fall asleep or difficulty staying asleep had to be parent rated as a problem on the modified ISQ. Each participant was required to meet one or both of the following criteria: difficulty falling asleep or staying asleep, defined as a chronic condition lasting longer than one month, occurring on at least 3-5 nights, and marked by the inability to regularly use self-soothing to enter a state of sleep (Buysse, Germain, & Moul, 2005). Children who were not previously evaluated and classified to be within the Autism Spectrum, who did not fall within the preferred

age range, and who did not meet the above criteria were excluded from the study. However, the 3 families that were excluded were referred to sleep clinics and given information on evidence/research-based treatment techniques.

Mothers of the participants recorded data nightly on a sleep diary throughout the baseline, intervention, and follow-up phases. Time of waking, bedtime, time child fell asleep, mealtimes, snack times, frequency and duration of night wakings, unusual circumstances, and additional notes on behavior were recorded on the sleep diaries. Any changes in medication were recorded as well. Baseline data were gathered for a minimum of one week or until a steady state of behavior was found. Upon completion of baseline data, a third phone meeting took place.

The third phone call was placed to discuss CRM, positive bedtime routines, and white noise procedures. During this call the researcher and parents collaborated to set up a consistent CRM routine in which eating, waking, sleeping, and napping were to occur at the same time each day. Parents were instructed to adhere consistently to these set times. Ferber's (2006) age-appropriate sleep requirement guidelines, baseline data, typical bedtime and waking time, and parent input were used in determining the CRM schedule. Also, the researcher and parents collaborated to set up 4-6 positive bedtime routines. Parents were instructed to adhere to the set bedtime routines within the child's sleeping environment each night (Ferber, 2006). Participants were asked to keep the calibrated white noise machines 24 inches from their child's head and to play the white noise continuously throughout the night. Participants were instructed to set the white noise generator between a 40 and 60 dB sound pressure level (SPL), levels that were acceptable and effective in previous studies with infants and preschoolers as participants (Borkowski, Hunter, & Johnson, 2001; Forquer & Johnson, 2005).

During the intervention phase, Ferber sleep guidelines were used for limit setting to reduce night waking activities, co-sleeping, and behavior problems if they occurred. Parents were instructed to keep children from viewing television right before bed, falling asleep in rooms other than their bedroom, exposure to light in the middle of the night, and early morning television. In addition, parents were instructed to be consistent with bedtime expectations, routines, and schedules to keep expectations clear.

Treatment lasted for one month, and participants were encouraged to continue using CRM, positive bedtime routines, limit setting, and white noise after formal treatment. One month subsequent to the end of the intervention, parents were asked to fill out an additional sleep diary for one week as a follow-up. A treatment satisfaction survey was emailed to each parent to assess the parent's views on the social validity of the study. The satisfaction survey was composed of 13 questions (Appendix F). Of these, 10 were on a 5-point Likert scale with scores ranging from 1 being *Strongly Agree* to 5 being *Strongly Disagree*. The remaining three questions asked what they liked most, what they liked least, and what they would change. At this time, parents were given specific instructions on how to return the white noise machines and were asked to keep the sound dial at the dB level that they used by the end of treatment.

The fourth phone call was made to discuss parent reactions to the treatment package and to address any additional questions or concerns. The final $25 money order was mailed at this time.

Research Design

A non-concurrent multiple baseline across participants design was used. Baseline data were collected for a minimum of 1 week or until a steady state of frequency was found. Baseline

lasted 12 days for the first participant. This was due to holidays, child sickness, and availability of white noise machines. After baseline was stable for each additional participant, treatment began with one week between participants.

The four variables analyzed to assess treatment effectiveness were duration of settling time and night wakings, frequency of night wakings, and parent satisfaction. Parent satisfaction was evaluated through the treatment satisfaction survey. In this case, the primary dependent variables (DV) were frequency of night waking, resistance going to bed, or both. Because the treatment was introduced at different points in time for each participant, extraneous factors can be ruled out if the change is seen across subjects only when the intervention is introduced (Barlow, Nock, & Hersen, 2008). Although each baseline and treatment introduction can be viewed as individual AB designs, if behaviors which have been targeted for treatment remain unchanged across baseline but change with treatment, then there is support in favor of the treatment (Barlow et al., 2008).

In the multiple baseline across participants approach, the target behaviors are the focus of concern (Barlow et al., 2008). Although there is more than one primary behavior in question (night waking, settling duration, or both), the design was not focused on multiple baselines across behaviors. This was due to the fact that the treatment addressed both frequency and duration of both behaviors simultaneously, rather than having different baselines for each behavior.

CHAPTER III

RESULTS

Three multiple baseline across participants designs were used: frequency of night wakings, duration of night wakings, and duration of settling. A separate graph was used for each of these. Three additional single-subject graphs with AB designs were used to depict the results of Child F due to special circumstances.

Overall mean settling duration for Child B, D, and E was 39.9 at baseline, 18.3 during treatment, and 15.3 minutes at follow-up (Table 2). Child A and C did not exhibit settling problems. Child F was not included in overall mean summary tables for settling duration due to the high number of illnesses and special circumstances that he experienced (Table 10). Three of the four children who had settling difficulties experienced a reduction in sleep latency during the treatment and follow-up phases. This reduction is seen when comparing these phases to baseline (Figure 1). Child F's settling duration improved during treatment and follow-up compared to baseline when special circumstances were controlled for (Figure 4).

Table 2. *Overall Settling Durations for Child A, B, C, D, & E*

	Baseline		Treatment		Follow-up	
	Mean	SD	Mean	SD	Mean	SD
Child A	N/A	N/A	N/A	N/A	N/A	N/A
Child B	61.2	40.1	33.2	11.5	17.1	9.1
Child C	N/A	N/A	N/A	N/A	N/A	N/A
Child D	32.8	17.6	6.4	4.5	9.7	12.9
Child E	25.6	22	15.3	10.7	19.2	5.8
Mean	39.9	26.6	18.3	8.9	15.3	9.3

Note: Child F's data were not included in summary table due to a number of special circumstances and illnesses.

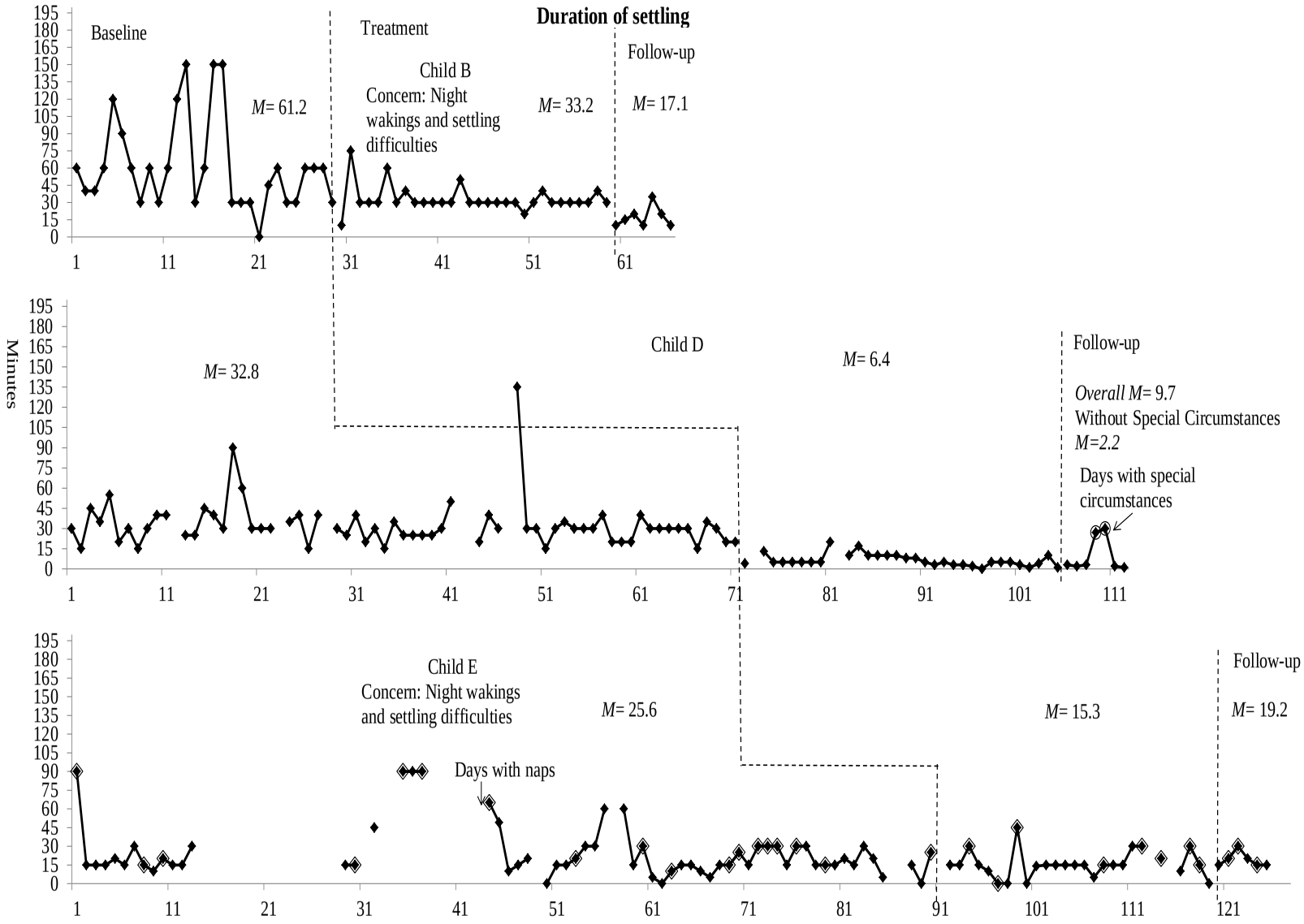

Figure 1. *Duration of settling for Child B, Child D, and Child E.*

Mean frequencies of night wakings for Child A, B, C, and E were 0.7 at baseline, 0.5 during treatment, and 0.1 by follow-up (Table 3). Child D did not exhibit night waking problems. Child F was not included in overall mean summary tables for night waking frequencies due to the high number of illnesses and special circumstances that he experienced (Table 10). The frequency of night wakings for four of the five children who had these difficulties is depicted in Figure 2. This figure shows a decrease in the frequency of night wakings during the treatment phase for 2 of the 4 children (Child A & Child B). The third child (Child C) and the fourth child (Child E) showed similar night waking frequencies during the treatment phase compared to baseline, but both showed reduction during follow-up. Child F is depicted separately in Figure 4 due to special circumstances. When special circumstances were controlled for, Child F showed a decrease in frequency of night wakings (Figure 5). All five children showed a reduction in frequency during follow-up. This can be seen in Figures 2 and 5.

Table 3. *Overall Night Waking Frequencies for Child A, B, C, D, & E*

	Baseline		Treatment		Follow-up	
	Mean	SD	Mean	SD	Mean	SD
Child A	0.75	0.8	0.2	0.4	0.1	0.4
Child B	0.7	0.5	0.2	0.4	0	0
Child C	0.8	0.7	0.8	0.9	0.1	0.4
Child D	N/A	N/A	N/A	N/A	N/A	N/A
Child E	0.6	0.6	0.6	0.6	0.3	0.5
Mean	0.7	0.7	0.5	0.6	0.1	0.3

Note: Child F's data were not included in summary table due to a number of special circumstances and illnesses.

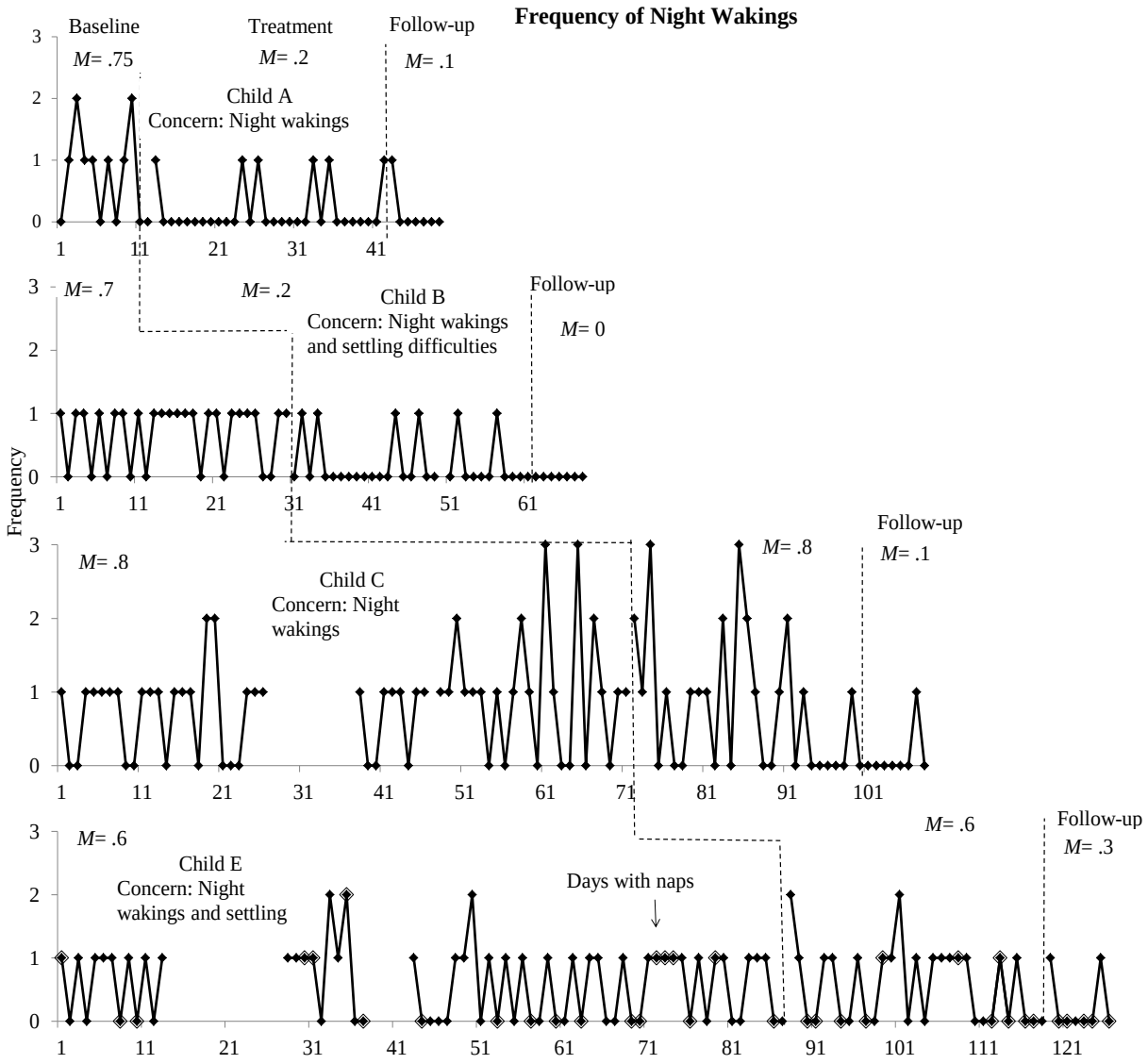

Figure 2. *Frequency of night wakings for Child A, Child B, Child C, and Child E*.

Including all nights in the duration average, the mean duration for these four children was 47.4 at baseline, 21.8 during treatment, and 5.5 minutes at follow-up (Table 4). This depicts lower durations for phases where the number of night wakings were reduced. Including only the nights in which waking occurred, the mean duration for these four children was 76.6 at baseline, 48.5 during treatment, and 25.6 during follow-up (Table 4). Child D did not exhibit night

waking problems. Child F was not included in overall mean summary tables for duration of night wakings due to the high number of illnesses and special circumstances that he experienced (Table 10). Durations of night wakings for four of the five children with this difficulty are depicted in Figure 3. All four children showed improvement during treatment and follow-up phases. Again, due to special circumstances, Child F's duration of night wakings are depicted separately in Figure 6. This child, also, showed a decrease in duration of night wakings when special circumstances were controlled for.

Table 4. *Overall Night Waking Durations for Child A, B, C, D, & E*

	Baseline			Treatment			Follow-up		
	Mean Nights With Wakings Only	Mean All Data	SD All Data	Mean Nights With Wakings Only	Mean All Data	SD All Data	Mean Nights With Wakings Only	Mean All Data	SD All Data
Child A	15	7.5	11	5	1	2	5	0.71	1.9
Child B	86.7	60.7	62.5	34.2	6.8	18.1	0	0	0
Child C	65.7	45.6	57.4	45.2	22.6	45.2	30	4.3	11.3
Child D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Child E	138.9	75.8	97.8	109.7	56.6	74.4	67.5	16.9	33.5
Total Mean	76.6	47.4	57.2	48.5	21.8	34.9	25.6	5.5	11.7

Note: Child F's data were not included in summary table due to a number of special circumstances and illnesses.

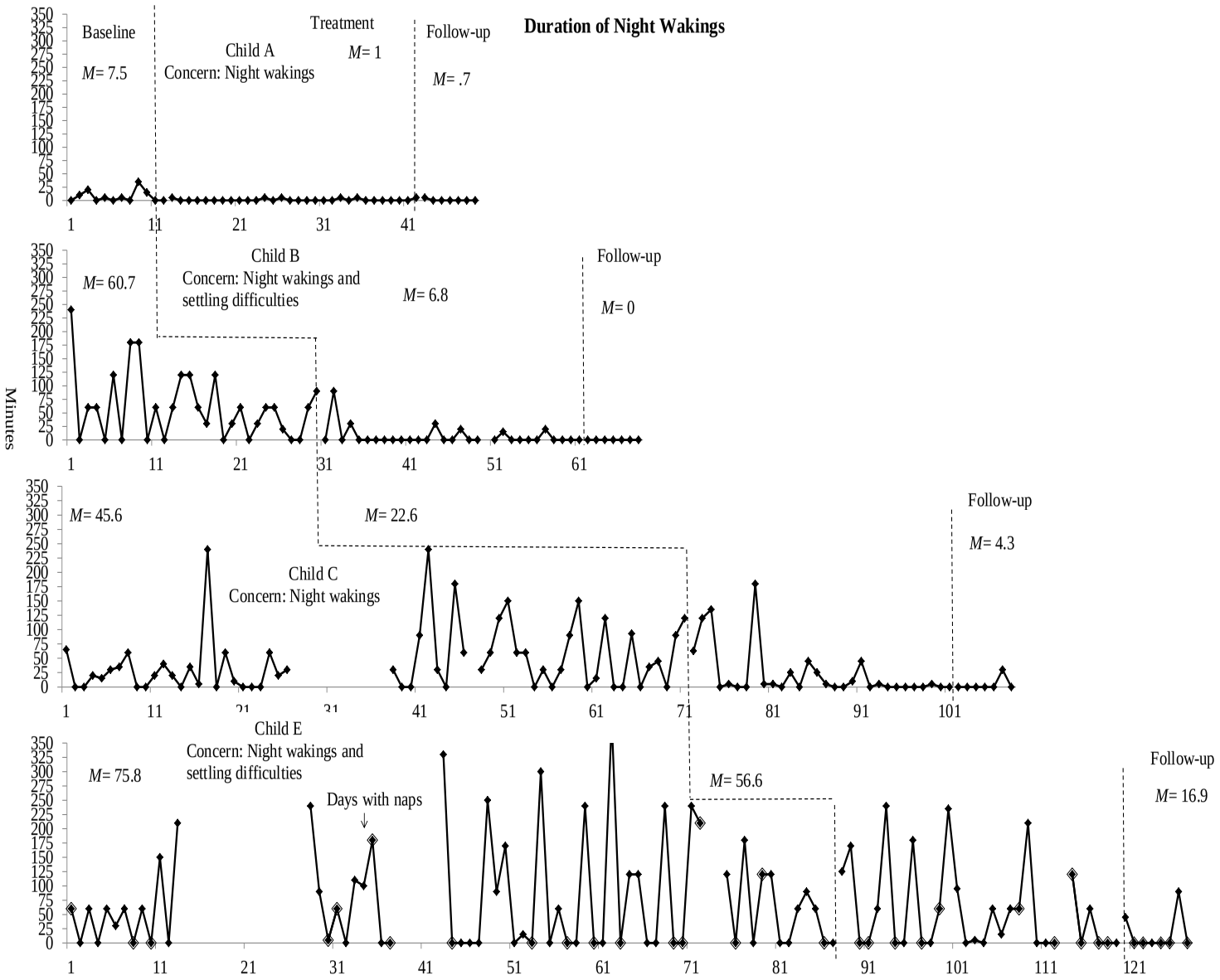

Figure 3. *Duration of night wakings for Child A, Child B, Child C, and Child E*.

Child A (Table 5) did not have settling problems but did exhibit night waking difficulties. Child A had an average of .75 night wakings per night during baseline. This was reduced to .2 per night during treatment and .1 during follow-up. With all days included, his duration of night wakings was low across phases with an average of 7.5 minutes during baseline, which was reduced to an average of 1 minute during treatment and .7 during follow-up. When only days with night wakings were included, his mean duration during baseline was 15 minutes, during treatment was 5 minutes, and during follow-up was 5 minutes. Child A showed reductions in number of night wakings during treatment by about 70%. Compared to baseline, Child A showed a frequency reduction of 87% during follow-up. With all days included, the duration of night wakings during treatment were reduced by 87%. Child A had a duration reduction of 90% during follow-up compared to baseline.

Table 5. *Means and Standard Deviations for Frequencies of Night Wakings and Duration of Night Wakings for Child A*

Condition	Circumstances	Mean Night Waking Frequencies	Standard Deviations for Night Waking Frequencies	Mean Duration for Only Nights with Wakings (in minutes)	Mean Night Waking Duration All Data (in minutes)	Standard Deviation for Night Waking Duration All Data
Baseline	Overall	0.75	0.8	15	7.5	11
Treatment	Overall	0.2	0.4	5	1	2
Follow-up	Overall	0.1	0.4	5	0.7	1.9

Child B's (Table 6) duration of settling was about 61 minutes per night prior to treatment. During treatment, this was reduced to about 33 minutes per night. A further improvement was seen during follow-up with his settling average decreasing to 17 minutes per night. Child B had an average of .7 wakings per night during baseline, which was decreased to .2 during treatment.

He experienced no night wakings during follow-up. With all days included, his average duration of night wakings was about 60 minutes per night during baseline. This was reduced to 6.8 minutes per night during treatment and 0 per night during follow-up. When only nights where wakings occurred were included, his average duration during baseline was 86.7 minutes, during treatment was 34.2 minutes, and during follow-up was 0. Child B had a reduction in settling time during treatment of 46% and 72% during follow-up. Child B showed reductions in number of night wakings during treatment by about 70%. With all data included, the duration of night wakings during treatment were reduced by 89%. Child B had zero night wakings during follow-up.

Table 6. *Means and Standard Deviations for Duration of Settling, Frequencies of Night Wakings, and Duration of Night Wakings for Child B*

Condition	Circumstances	Mean Settling Duration (in minutes)	Standard Deviations for Settling Duration	Mean Night Waking Frequencies	Standard Deviations for Night waking Frequencies	Mean Duration for Only Nights with Wakings (in minutes)	Mean Night Waking Duration All Data (in minutes)	Standard Deviation for Night Waking Duration All Data
Baseline	Overall	61.2	40.1	0.7	0.5	87.6	60.7	62.5
Treatment	Overall	33.2	11.5	0.2	0.4	32.4	6.8	18.1
Follow-up	Overall	17.1	9.1	0	0	0	0	0

Child C (Table 7) did not have settling difficulties. During baseline Child C had an average of .8 night wakings per night. During treatment this did not change, but by follow-up it was reduced to .1 per night. Follow-up included one night where Child C experienced a nightmare and a subsequent waking period. With that night excluded, follow-up data were reduced to zero. When all days were included, an even greater improvement was seen in the length of night wakings which was reduced from a baseline average of about 45 minutes to a

treatment average of 22.6 minutes and 4.3 minutes during follow-up. When only days with night wakings are included in duration average, his mean during baseline was 65.7 minutes, during treatment 45.2 minutes, and during follow-up 30 minutes. Again, with nightmare data excluded duration of night wakings was reduced to 0 during follow-up. With all data included, his length of night wakings was cut in half during treatment and reduced by 90% when all follow-up data were included.

Table 7. *Means and Standard Deviations for Frequencies of Night Wakings and Durations of Night Wakings for Child C*

Condition	Circumstances	Mean Night Waking Frequencies	Standard Deviations for Night Waking Frequencies	Mean Duration for Only Nights with Wakings (in minutes)	Mean Night Waking Duration All data (in minutes)	Standard Deviation for Night Waking Duration All Data
Baseline	Overall	0.8	0.7	67.5	45.6	57.4
Treatment	Overall	0.8	0.9	45.2	22.6	45.2
Follow-up	Overall (with Nightmare)	0.1	0.4	30	4.3	11.3
Follow-up	Without Nightmare	0	0	0	0	0

Note: Special circumstances include one night in which Child C experienced a nightmare.

Child D (Table 8) had an average settling duration of about 33 minutes per night. This was reduced to 6.4 minutes per night during treatment. Child D's mean settling time was 9.7 minutes during follow-up when all data were included. With two nights excluded from the follow-up data due to special circumstances, mean settling time was reduced to 2.2 minutes per night. During baseline, settling duration ranged from 15 minutes to 135 minutes. During treatment, settling duration ranged from 1 minute to 20 minutes. During treatment, child D's settling time was reduced by 80% and by 70% during follow-up compared to baseline when all

follow-up data are included. When the two days that child D's mother reported were atypical were excluded, follow-up data showed a settling time reduction of 93% compared to baseline. Child D did not have night waking difficulties.

Table 8. *Means and Standard Deviations for Durations of Settling for Child D*

Condition	Circumstances	Mean Settling Duration (in minutes)	Standard Deviation for Settling Duration
Baseline	Overall	32.8	17.6
Treatment	Overall	6.4	4.5
Follow-up	Overall	9.7	12.9
Follow-up	Days without Special Circumstances	2.2	0.8

Note: Special circumstances include one night that Child D had a fight with his sister right before bed and one night that Child D spent with his grandmother in which routine was not followed.

Child E's (Table 9) average settling time during baseline was about 26 minutes. During treatment and follow-up, settling durations were 15.3 minutes and 19.2 minutes, respectively. Child E's frequency of night wakings remained stable throughout baseline and treatment but improved during follow-up. She had an average of .6 night wakings per night, which was reduced to .3 per night during follow-up. It should be noted that although frequency of night wakings remained stable through the treatment period, the duration of these night wakings began to improve with treatment. With all days included, her duration averaged approximately 76 minutes during baseline. These reduced to about 57 minutes during treatment and about 17 minutes during follow-up. When only days with night wakings were included, her average duration was 138.9 minutes during baseline, 109.7 minutes during treatment, and 67.5 minutes during follow-up. Although follow-up data showed that settling increased from treatment, compared to baseline, it was still down by 25%. Follow-up showed a frequency reduction of 58% and a duration reduction of 78% (when all days were included) compared to baseline data.

Table 9. *Means and Standard Deviations for Duration of Settling, Frequencies of Night Wakings, and Durations of Night Wakings for Child E*

Condition	Circumstances	Mean Settling Duration (in minutes)	Standard Deviation for Settling Duration	Mean Night Waking Frequencies	Standard Deviations for Night Waking Frequencies	Mean Duration for Only Nights with Wakings (in minutes)	Mean Night Waking Duration All Data (in minutes)	Standard Deviation for Night Waking Duration All Data
Baseline	Overall	25.6	22	0.6	0.6	138.9	75.8	97.8
Treatment	Overall	15.3	10.7	0.6	0.6	109.7	56.6	77.4
Follow-up	Overall	19.2	5.8	0.3	0.5	67.5	16.9	33.5
Baseline	Days without Naps	21.3	17.4	0.6	0.5	141	85.2	103.2
Baseline	Days with Naps	36.5	28.3	0.5	0.6	105.8	35.3	66.7
Treatment	Days without Naps	11.6	7.6	0.7	0.6	112.1	71.4	84
Treatment	Days with Naps	23.3	12.7	0.3	0.5	80	21.8	40.5
Follow-up	Days without Naps	16.7	2.9	0.7	0.6	67.5	45	45
Follow-up	Days with Naps	21.6	7.6	0	0	0	0	0

Note: Special circumstances include days with naps and days without naps. Overall data for all three phases include days with naps and without naps.

Child F's (Table 10) overall data did not include days in which he was sick. This was due to starting treatment during a week where he was ill, which affected the treatment approach as well as night waking frequencies, waking duration, and settling duration. As a result, all data where Child F was sick were discarded during all phases of the study (i.e., only data for healthy days were taken into consideration). His overall mean settling duration was 28 minutes during baseline and was reduced to 14 minutes during treatment. During follow-up, the settling time went back up to pre-treatment levels (27.3 minutes). Child F's overall frequency of night wakings during baseline was .3 per night. During treatment and follow-up his average number of night wakings was .35 and .3, respectively. With all days included, his overall duration of night wakings were stable across baseline and treatment (mean of 30 minutes), but this was

reduced during follow-up to a mean of 9.3 minutes per night. When only days with night wakings were included in the mean, his average duration during baseline was 93.1 minutes, during baseline, 96.2 minutes, and during follow-up 32.5 minutes.

Child F experienced a spontaneous recovery period during baseline. His mean settling time was stable across baseline for all conditions and was between 26-28 minutes. This was reduced to an average of 14 minutes after treatment in all conditions but returned to pre-treatment levels during follow-up. Without the spontaneous recovery period, night waking frequencies were .4 per night during baseline, .35 per night during treatment, and .3 during follow-up. Without special circumstances (Table 6), his number of night wakings were .4 per night during baseline, .35 during treatment, and .2 during follow-up. When spontaneous recovery data were removed from baseline data, his average duration of night wakings was 41 minutes during baseline. This was reduced to 31 minutes during treatment and 9.3 minutes during follow-up. This average duration includes days with and without night wakings. When only days with night wakings were averaged, the mean duration was similar across baseline and treatment. The mean duration of night wakings declined in follow-up to 32.5 minutes. When special circumstances were removed from the data, his duration of night wakings were 42 minutes during baseline, 27 minutes during treatment, and 1 minute during follow-up. This average duration includes days with and without night wakings and depicts lower durations during phases where fewer night wakings occurred. When only days where night wakings occurred were included, his average was 102.9 minutes during baseline, 88.6 minutes during treatment, and 5 minutes during follow-up. Child F's settling duration, night waking frequency, and night waking duration is depicted in Figure 4, Figure 5, and Figure 6, respectively.

Table 10. *Means and Standard Deviations for Durations of Settling, Frequencies of Night Wakings, and Durations of Night Wakings for Child F*

Condition	Circumstances	Mean Settling Duration (in minutes)	Standard Deviation for Settling Duration	Mean Night Waking Frequencies	Standard Deviations for Night Waking Frequencies	Mean Duration for Only Nights with Wakings (in minutes)	Mean Night Waking Duration All Data (in minutes)	Standard Deviation for Night Waking Duration All Data
Baseline	Overall	27.8	11	0.3	0.5	93.1	30.6	55.9
Treatment	Overall	14	10.9	0.35	0.6	96.2	30.8	56.3
Follow-up	Overall	27.3	16.3	0.3	0.5	32.5	9.3	22.4
Baseline	Without Spontaneous Recovery	27.2	12.1	0.4	0.5	92.6	40.6	61.7
Baseline	Without Special Circumstances	26	8.7	0.4	0.5	102.9	42.4	64.2
Treatment	Without Spontaneous Recovery	14	10.9	0.4	0.6	96.2	30.8	56.3
Treatment	Without Special Circumstances	14	11.2	0.4	0.6	88.6	27	52.4
Follow-up	Without Spontaneous Recovery	27.3	16.3	0.3	0.5	32.5	9.3	22.4
Follow-up	Without Special Circumstances	19.2	10.5	0.2	0.4	5	1	2.2

Note: Due to Child F being sick in beginning of the treatment phase, all data points that included sickness were thrown out in all phases for proper comparison. Overall data includes a spontaneous recovery: a long span of time that he experienced no night wakings. Special circumstances during baseline and treatment included nights without melatonin, vacations, visitors, and one diaper change. Special circumstances during follow-up included two days that Child F's mother felt difficulties at school caused night time problems.

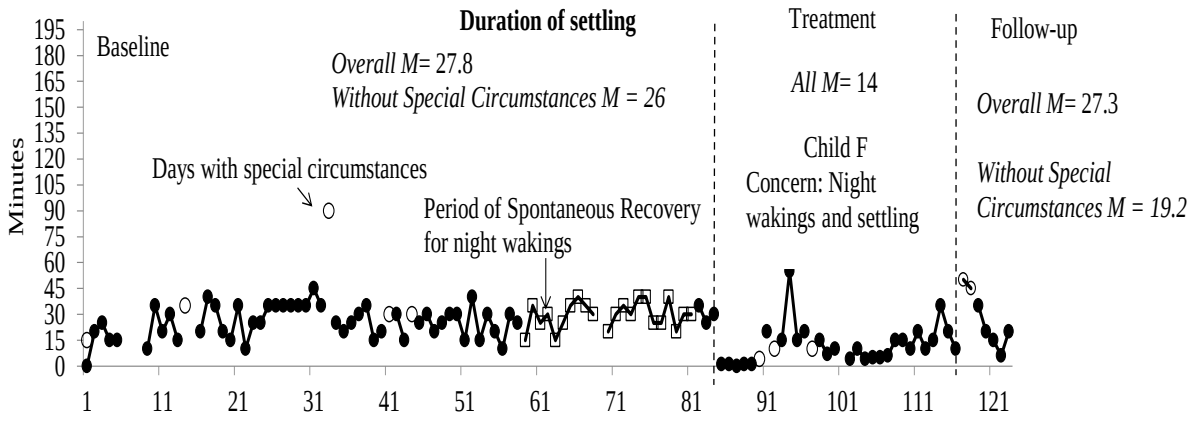

Figure 4. *Duration of settling in minutes for Child F.*
Overall data: due to a period of sickness at beginning of treatment, sick days across all phases were thrown out. *Spontaneous Recovery:* period in which Child F stopped having night wakings with no known cause. Special Circumstances include nights with no melatonin, one night time diaper change, two difficult school days, visitors and vacations.

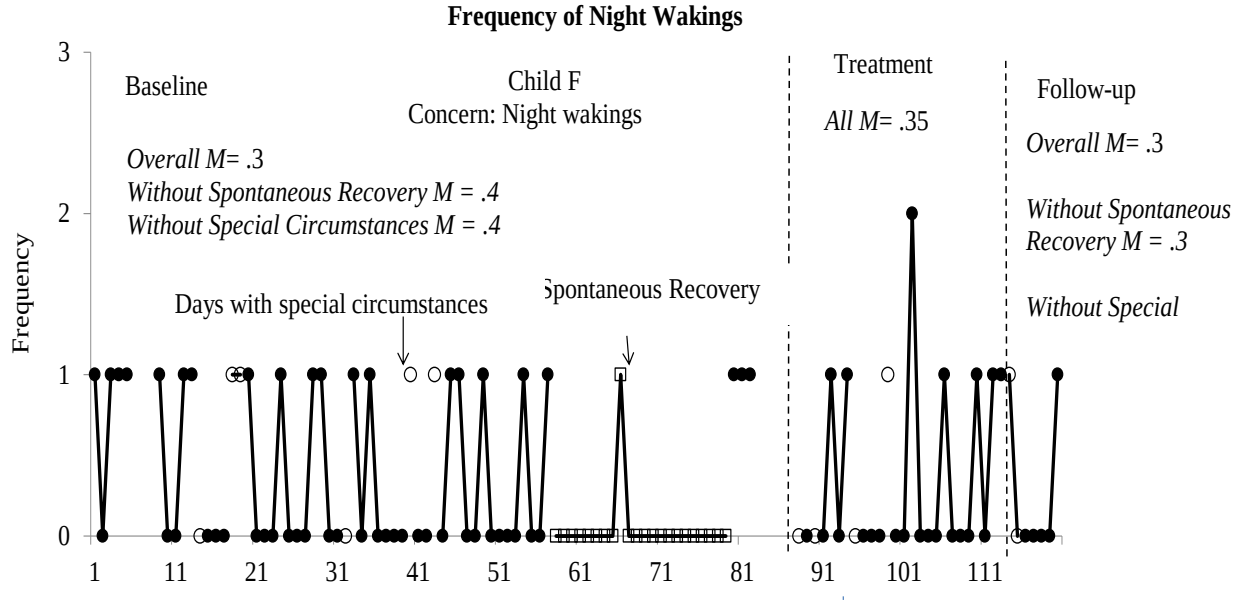

Figure 5. *Frequency of night wakings for Child F.*
Overall data: due to a period of sickness at beginning of treatment, sick days across all phases were thrown out. *Spontaneous Recovery:* period in which Child F stopped having night wakings with no known cause. Special Circumstances include nights with no melatonin, one night time diaper change, two difficult school days, visitors and vacations.

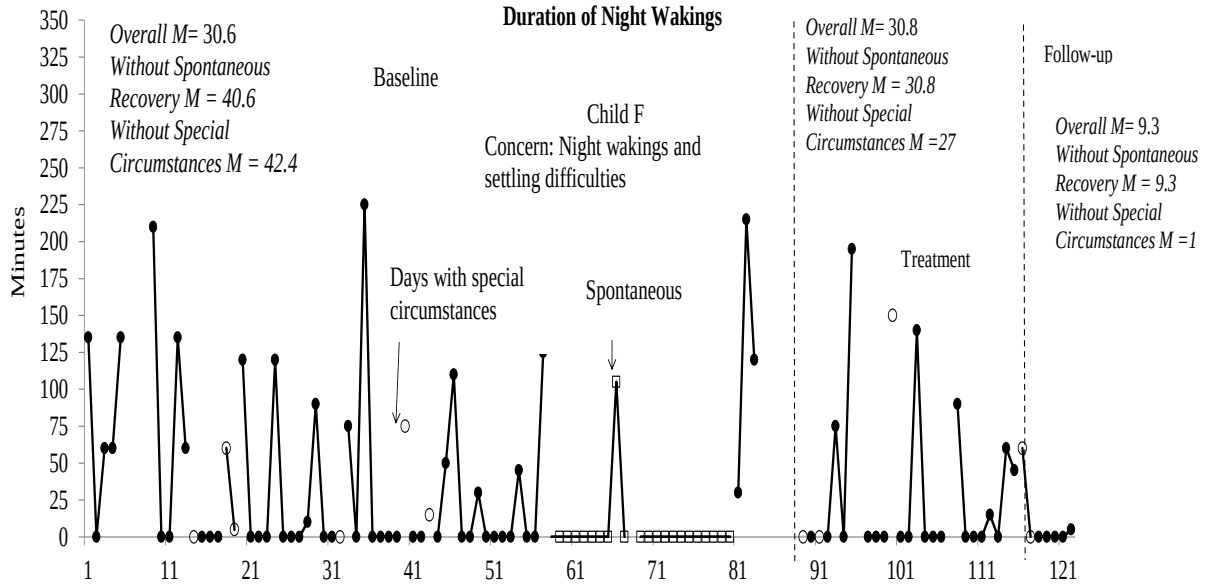

Figure 6. *Duration of night wakings in minutes for Child F.*
Overall data: due to a period of sickness at beginning of treatment, sick days across all phases were thrown out. *Spontaneous Recovery:* period in which Child F stopped having night wakings with no known cause. Special Circumstances include nights with no melatonin, one night time diaper change, two difficult school days, visitors and vacations.

Treatment integrity checklists were used to determine how closely participants followed treatment guidelines. Child C's mother reported having difficulty adhering to the limit setting guidelines. According to her sleep diary data and treatment integrity checklists, she used limit setting 71% of the time during the first week of the treatment and 100% during the last week of the treatment. Child A and D's mothers reported using limit setting 100% of the time both during the first and last week of treatment. Child E's mother reported adherence of 71% during the first week and 100% during the last week as well. The mothers of children B and E did not fill out treatment integrity checklists; as a result their adherence to limit setting could not be determined. Child E's mother reported having difficulty with both limit setting and CRM.

Her sleep diary data indicated adherence to bedtimes and wake times were 57% during the first and last week of treatment. Her adherence to meal times was 62% during the first week and 67% during the last week. The 5 remaining participants reported a range of 86%-100% (mean of 91.6%) adherence to bedtimes during the first week and last week of treatment. Additionally, they reported a range of 71%-100% (mean of 82.6%) adherence to wake times during the first week and a range of 56%-100% (mean of 85.6%) during the last week of treatment. They reported a range of 38%-100% adherence to meal times (mean of 82.6%) during the first week of treatment and a range of 76%-100% for the last week of treatment (mean of 87.6%). The four participants that filled out the treatment integrity checklists reported high compliance to the use of bedtime routines and white noise. They all reported adherence of 100% to both during the last week of treatment.

All participants returned the white noise machines and calibrations were checked with a with a portable decibel reader. The overall mean dB level was 71 dBs and the standard deviation was 7.8. The range of dBs recorded was at a high of 83 dBs and a low of 61 dBs. One returned machine showed a reading below audible sound level and was excluded from the means and standard deviations.

On the *Social Validity Questionnaire*, parents agreed that the treatment approach was effective in reducing their children's night time difficulties. A 5-point Likert scale was used by raters with 1 being *strongly agree* and 5 being *strongly disagree*. For a breakdown of results, please see Table 11. Question one asked if the daily treatment schedule fit into each family's regular routine and received an average rating of 1.5, with a standard deviation of .5. Question two addressed whether or not the bedtime routines employed were appropriate and received an overall rating of 1.2 and a standard deviation of .4. Parents rated the appropriateness of white

noise in question three. Again, the average rating was 1.2 with a standard deviation of .4. The appropriateness of the treatment package and whether or not it was explained in an understandable way were rated in questions four and five. Both questions received averages of 1 with standard deviations of 0. Parents' ability to implement the package was rated in question 6, which received an average of 1.2 and standard deviation of .4. The benefits of the treatment being worth the effort was rated in question 7 and received an average of 1 with a standard deviation of 0. Question eight addressed whether or not treatment reduced the child's night time difficulty and the average score was 1.2 with a standard deviation of .4. Questions nine and ten asked if they would use one or more of the approaches again and if they would recommend one or more of these approaches to someone else. Both questions received averages of 1 and standard deviations of 0.

Table 11. *Social Validity Questionnaire*

Question	Answer						Average	Standard Deviation
	Parent A	Parent B	Parent C	Parent D	Parent E	Parent F		
The bedtime, meal time, nap time, and wake time schedules used during treatment fit into our family's regular schedule.	2	2	1	2	1	1	1.5	0.5
The use of bedtime routines during this treatment were appropriate to help my child to prepare for bed.	1	2	1	1	1	1	1.2	0.4
The use of white noise during this treatment was appropriate to help my child fall asleep or stay asleep longer.	2	1	1	1	1	1	1.2	0.4
The treatment was appropriate for my child.	1	1	1	1	1	1	1	0
The treatment was described in an understandable way.	1	1	1	1	1	1	1	0
Implementing the treatment was within my skill level.	1	2	1	1	1	1	1.2	0.4
The results obtained from the treatment were beneficial enough to warrant the amount of effort that it took to implement and maintain the treatment.	1	1	1	1	1	1	1	0
The treatment reduced my child's night time difficulties.	1	1	1	1	1	2	1.2	0.4
I would use one or more of the three approaches of this treatment again.	1	1	1	1	1	1	1	0
I would recommend one or more of the three approaches of this treatment to others.	1	1	1	1	1	1	1	0

Note: Evaluation of Treatment Package (CRM, Bedtime Routines, & White Noise) social validity questionnaire was rated using a 5-point Likert scale (1 = Strongly Agree- 5 = Strongly Disagree).

CHAPTER IV

DISCUSSION

Although a number of studies have been done to determine what sleep treatments may help remediate sleep difficulties in typically developing children, few have been carried out with children with ASD. In addition, there are no published studies that show a treatment package approach using CRM, PBR, limit setting, and white noise. However, Knight and Johnson (2013) found favorable results with the use of CRM, PBR, white noise, and graduated extinction to reduce number of night wakings and settling duration for three children with ASD from 4- to 5-years-old. The current study lends support to the efficacy of treatment package applications such as these. The current study found a treatment package with three of the four similar components (CRM, positive bedtime routines, and white noise), coupled with limit setting when appropriate, effective and accepted by the parents for children with ASD who were slightly younger and older (3- to 6-years-old).

Three of the 4 children with settling difficulties experienced a reduction in duration when comparing follow-up to baseline (Table 2). The fourth child with settling difficulties showed a reduction in duration during follow-up when compared to baseline when special circumstances were controlled (Table 10). When comparing baseline to follow-up, all 5 children experienced a reduction in frequency of night wakings as well (Table 3 and Table 10). Results show by follow-up all 5 children experienced a reduction in night waking difficulties.

Although some participants experienced few departures from their typical lifestyle or routine, Child C, D, E and F experienced circumstances that may warrant further discussion. Child C started treatment as a co-sleeper, which was controlled for during treatment with limit

setting. Initially during treatment, Child C's mother reported difficulty sticking consistently to limits. As limit setting improved, his co-sleeping, frequency of night wakings, and duration of night wakings declined. During the last week of treatment, he had only one night waking, which was 5 minutes in duration. In addition, he experienced a nightmare during follow-up, but no other nightmares where noted during any other phase.

According to Ferber (2006), nightmares are typical nighttime occurrences with children and often require comfort from parents. In other words, a nightmare can cause a waking which is not caused by maladaptive bedtime routines, limit settling difficulties, or sleep association problems. With the exception of one night mare, Child C's night wakings were reduced to 0 during follow-up. Because this study is concerned with maladaptive bedtime routines and other bedtime difficulties, Child C's data were presented both with the nightmare included and without (Table 7). Although both sets of data are presented, nightmares are a common occurrence among children with and without bedtime difficulties. When looking for data with abnormal sleep situations, it may not be necessary for such data to be included unless nightmares themselves are causing extensive difficulty (in this case, they were not).

Child D's mother reported two days during follow-up in which she felt Child D's experience was atypical. On one of these nights, child D had a fight with his sister and was put directly to bed as a result. His mother reported that he talked to himself for a while before going to sleep while he was lying in bed. On the other night, child D slept at his grandmother's house without his typical routine. With these two days excluded from follow-up data, an even greater improvement was seen in his settling time compared to baseline. Because Child D's mother reported these days as atypical and because no other data with sibling fights directly prior to bedtime or non-routine visiting days were reported in other phases, it may be more accurate to

view Child D's follow-up data with these two days excluded. However, both sets of data were presented (Table 8).

Child E's mother verbally reported finding it difficult to adhere to a consistent CRM schedule. However, the duration of Child E's night wakings were reduced even further the more consistently she followed the daily schedule. It should be noted that when days with naps were analyzed, a reduction in duration of night wakings was seen in comparison to overall data in baseline, with a further reduction seen during treatment and follow-up. This may be due to a more consistent routine being followed when naps were implemented, because naps were part of her daily schedule. There were more days without naps than with naps during treatment, which reduced the treatment numbers compared to the follow-up numbers. This suggests that by follow-up the parent of Child E was setting more consistent daily routines and limits. Follow-up had an equal number of days with and without naps. However, settling time appeared to increase on days with naps in comparison to overall data and days without naps (Table 9). Although settling time increased on days with naps, Child E slept with less fragmented sleep during this time. A reduction in settling time was still seen from baseline to treatment and follow-up on days with naps.

Child E's mother initially had difficulties with limit setting and following a consistent daily schedule. Again, as these improved, the child's frequency and duration of night wakings reduced. In addition, during the last week of treatment, Child E exhibited only 2 night wakings. One night waking lasted 120 minutes, but Child E was sick on this night. The other night waking lasted 60 minutes. During baseline, her night wakings ranged from a low of 5 minutes to a high of 330 minutes in duration.

Because Child F began treatment while sick, treatment integrity was affected during his period of sickness. As a result, days with illness were removed from all phases of the study, including the spontaneous recovery period and special circumstances, to allow for proper comparison.

Child F's overall data show low averages for baseline due to a period of 22 days during which the child exhibited a spontaneous recovery. The mother of child F reported that long periods of normal sleep in between long periods of disrupted sleep was typical of his sleep cycle. Child F's mother reported that there was no known cause for this spontaneous recovery period. Additionally, sleep diary data did not show a change in pre-treatment routine or environmental experience. This period should be taken into account when viewing all phases of child F's data. When spontaneous recovery data were removed from baseline data, Child F's average duration of night wakings was 41 minutes during baseline. This was reduced to 31 minutes during treatment and 9.3 minutes during follow-up.

In addition to the spontaneous recovery and sickness, Child F experienced special circumstances. Special circumstances during baseline and treatment included nights without melatonin, vacations, visitors, and one nighttime diaper change. Special circumstances during follow-up included two days that Child F's mother felt difficulties at school caused night time problems. The days that were excluded for special circumstances were atypical compared to other data that Child F exhibited.

When spontaneous recovery and special circumstances were controlled for, Child F showed an improvement in night waking frequency and duration during treatment. Compared to all baseline data, follow-up data showed a reduction in night time waking numbers and durations. However, settling time returned to pre-treatment levels during follow-up, but night time sleep

fragmentation was reduced. Many of these special circumstances are typical problems that families face, which may affect how the treatment is applied or when it is started. This data suggests that in situations where special circumstances arise, treatment may need to run longer or be started during a less busy time.

Even when participants did not initially see reductions in night waking frequency or duration, follow-up data shows reduction. This may indicate two things. First, it may suggest that parents liked the treatment enough to continue using it during the month between follow-up and end of treatment. Second, some families may need to use the treatment for a longer period before seeing results. This may be especially true in cases where parents are having difficulty with CRM and limit setting or when there are special circumstances during the initial treatment phase.

There are some concerns regarding the validity of sleep diary data due to the subjectivity of possible over or under-estimation of night waking or settling duration. Although some studies have used more objective measures, such as actigraphy, there is some research that indicates these two methods produce similar data (Sadeh, 1994). As an integrity check, both parents in two of the participating families separately filled out sleep diaries once per week. Child A's parents had an inter-observer reliability of 89%. They reported a wake time, a lunch time, a dinner time, and a bedtime that were more than 5 minutes different from one another. All other data from parents recording independently from one another were similar (within 5 minutes). All discrepancies occurred on only one of the sleep diary checks and differences ranged from 9-30 minutes, with sleep time being the lowest difference and lunch time being the highest difference. All of their other sleep diaries coincided well. Child E's parents had an inter-observer reliability of 100%. Bedtimes, wake times, and eating times were considered accurate

if they were reported to be within 5 minutes of each other. This acted as an additional control and consistent data were reported.

Another concern includes parents' ability to stick to a consistent daily schedule and set limits. Each participant's discipline situation was unique to that family. As a result, some participants needed to apply more limit setting than others. Child E's mother reported verbally and in sleep diaries that it was difficult for her to set limits and keep a daily schedule (CRM). However, the data support that the longer she used the treatment and increased implementing CRM consistently, an even greater reduction in night waking frequency and duration occurred. This can be seen in Child E's follow-up data. Likewise, initially during treatment, Child C's mother reported having a difficult time setting limits for co-sleeping. Like Child E's data, Child C shows an even greater improvement the longer treatment continued. By the end of treatment, both mothers verbally reported feeling more comfortable having a set schedule and limits. However, parents who have a harder time setting limits with their children or setting consistent schedules may have a harder time implementing the treatment themselves, or it may take longer to see dramatic reductions in sleep difficulties. These findings are consistent with Johnson and Lerner (1985) who found that parents who adhere closely to behavior sleep treatments get better results, whereas those who do not adhere to the set treatments find weak effects.

Another concern to the study may be the dB levels on the white noise machines. Participants were asked to set white noise machines within a range of 40-60 dBs. However, the range of dBs upon return was 61-83 dBs. One white noise machine (used by Child D) was returned with the dial set below the audible sound limit. Because Child D's mother consistently reported using the white noise machine within the appropriate range, it is assumed that she either did not follow return instructions or that the dial changed during the return shipping process. As

a result, this machine was not added to the means and standard deviations of the others. Since all of the white noise machines were shipped back by participants, it should be noted that the sound dials on all the machines could have been affected during this process. All parents were instructed to set the sound dials appropriately both during treatment and upon return. All parents reported being within the appropriate sound dial range during treatment. Four previous studies using white noise machines have found that ranges up to 75 dBs are effective in reducing night time difficulties (Borkowski, Hunter, & Johnson, 2001; Forquer & Johnson, 2005; Forquer 2006; Forquer & Johnson, 2007). The current study had a mean dB level of 71 dBs. In addition, some variation in sound level is to be expected. Although each participating family was instructed to keep the child's head 2 feet from the white noise machine, body movements during sleep may cause this distance (and therefore the expected sound level) to differ slightly from participant to participant.

Parents rated the treatment package to be effective and within their ability levels on the Social Validity Questionnaire. Child A's and E's mothers reported that they strongly agreed that the treatment was appropriate, within their skill level, and that it was worth the amount of effort it took. Child B's mother stated, "I am pleased with the results of this study on my son's sleeping habits. I'm very happy that we were able to be a part of this study." Child C's mother reported that using the treatment on Child C also had an effect on her younger daughter's sleep difficulties. She reported that her younger daughter did not qualify for the study, because she was typically developing, and the mother implemented the same treatment with her as with Child C. Child C's mother reported that she felt the treatment was successful for both of her children. On the treatment survey she stated, "I am happy to report that this program has not just helped [Child C] but my three other children." Child C's mother reported feeling the strict

schedule was helpful and that she would recommend this and the other methods to others, but she also mentioned following a consistent schedule at first was a little "daunting." Child D's mother stated, "This has been wonderful."

Seven weeks after the last participant completed the study a second follow-up was sent by email to all participants. Participants were asked approximate weekly nighttime wakefulness averages and to rerate the overall effectiveness of the treatment package (question 8, Appendix G). Parents of Child C, Child D, and Child E responded. Child C's mother reported that Child C wakes only about once per month for a potty break and returns to bed promptly. Child D's mother reported that Child D falls asleep within minutes. Child E's mother reported that Child E takes about 15-20 minutes to fall asleep each night, and he has had only two night wakings since the end of the study (about 9 weeks ago for Child E). All three parents *strongly agreed* that the treatment package helped reduce their child's night time difficulties, giving question 8 of the social validity questionnaire a rating of 1. Because only half of the participants responded, this additional follow-up data might be biased. There is the possibility that only participants experiencing a continuation with treatment success responded. Any additional responses from participants will be included postscript.

One limitation of this study is the small sample size. It is unclear whether or not results will generalize to a larger population. Also, there were uncontrolled variables among participants that further research could control. These include differences in use and dose of melatonin, degree of functioning along the autism spectrum, and use of co-sleeping.

An additional limitation may be implementing CRM consistently. Some parents, especially those with busy lifestyles or during vacations and holidays, might find CRM difficult to implement. Similarly, limit setting appeared to be more difficult for parents who co-slept and

for parents dealing with more undesired behaviors. Two parents reported that adherence to CRM and limit setting was an issue. Additionally, two parents did not fill out the treatment integrity checklists, which may be another indicator reflecting social validity because it may have been hard for them to carry out everything. Lecuyer and Houck (2006) reported that children whose mothers set appropriate limits in toddler years by using a teaching style method have better behavior, socialization, and self-concept at 5 years of age. Likewise, Ferber (2006) reported that inappropriate sleep associations, increased problem behaviors at bedtime, and longer sleep latency can be a result of parents who have difficulty setting limits. These sleep time difficulties may also be more prevalent in children with autism, because problem behaviors may increase parents' tendency to give in to maladaptive routines (Souders et al, 2009).

Additionally, some participants had special circumstances such as illness, busy lifestyles, vacations, or visitors that may have impacted the results. This may actually serve to lend validity to the study. Readers were supplied with sets of data with and without circumstances included (both for reader interest and for proper comparison). However, even when all data with special circumstances were left in, improvement was still evident in participants' nighttime wakefulness. This may speak to the real-world applicability of this treatment package approach because most children will experience these situations in daily life.

Despite limitations, these results lend support to behavioral treatments being effective in treating sleep difficulties for children along the autism spectrum. Furthermore, Knight and Johnson (2013) used a similar package approach with similar results suggesting the usefulness of some of these package components. Also, the current study presents data for children who do and do not co-sleep and who do and do not take melatonin, which may be a useful addition to current literature. Many current studies that explore behavioral treatment packages to reduce

sleep problems in children with autism either do not make these comparisons, do not cite them in their work, or have too few participants for comparison (Vriend et al., 2011). This allows some comparison of groups and suggests the treatment is effective across all of these conditions. Furthermore, mothers reported being satisfied with the treatment package and their ability to use it. These results indicate that they feel this treatment is an acceptable and useable approach to decreasing their children's sleep difficulties. Knight and Johnson (2013) found high parent satisfaction with their behavioral treatment package approach. Similarly, the current study found even higher parent satisfaction with the use of CRM, PBR, limit setting, and white noise. These results suggest that similar behavioral methods are within parents' skill level and are socially acceptable.

There are a number of possible ways to expand on this study in future research. For example, including more age ranges into the study may help determine if this treatment approach is beneficial across age levels. Additionally, it may be helpful to evaluate other combinations of treatments tried in this study to determine if there is a more effective combination. Another approach would be to evaluate each treatment component separately to see what effect each has on its own. Determining the best or most effective treatment approach would be beneficial to children and families that deal with ASD and associated sleep difficulties. Future studies may show that due to the heterogeneous nature of autism, different treatments may work better for different families, depending on their unique situation.

APPENDICES

APPENDIX A

INFORMATION FLYER

Study to Improve Sleep in Children with Autism

Central Michigan University,
Mount Pleasant
Department of Psychology

A study using a combination of treatments to improve sleep difficulties in children with autism is being conducted at Central Michigan University. Our hope is to increase ease of falling asleep at night and to reduce night waking.

Who is Eligible?

Children with Autism
Ages 3 - 6
Difficulty going to bed, waking at night, or both

What will you be asked to do?

Keep a nightly diary of your child's sleep habits
Provide a consistent bedtime, wake time, meal time, and naptime (if applicable) for your child
Use of bedtime routines
Use of white noise machine (provided by CMU)

Compensation

You will receive up to $100 for your participation in this study.

If you have any questions or are interested in participating, please contact:

Karina (Livingston) Koenig, Principle Investigator, at (920) 539-9671 or Email:

livin1km@cmich.edu

APPENDIX B

ADULT CONSENT FORM

CMU
CENTRAL MICHIGAN UNIVERSITY

MCESA Consent Form

Study Title: Reducing Nighttime Wakefulness in Children with Autism:
A Treatment Package Approach

Research Investigators: Karina (Livingston) Koenig, Department of Psychology: Carl Merle Johnson, Ph.D.

Contact information: 920-539-9671 or livin1km@cmich.edu:
(989) 774-6493 or johns1cm@cmich.edu

Introductory Statement
Karina (Livingston) Koenig & Carl Johnson are requesting permission to place flyers informing potential participants of the opportunity to participate in a research study investigating treatments to reduce sleep problems and night time difficulties in children with autism.

What is the purpose of this study?

We are researching a combination of treatments for bedtime struggles and night waking that parents can use to reduce night time difficulties for children with autism. These are all nondrug treatments. We want to know if sleep can be improved in children with autism and if parents like or dislike these different approaches and why.

How will participants be recruited?

Flyers requesting volunteer participation will be placed within MCESA facilities. Participants will not be directly solicited or pressured to participate in this research project in any way. All participants may withdraw consent or discontinue participation at any time.

Who can I contact for information about this study?

Karina (Livingston) Koenig
livin1km@cmich.edu
(920) 539-9671

Carl Johnson, Ph.D.
Johns1cm@cmich.edu
(989) 774-6493

All participants in this study will be participating on purely a volunteer basis. A flyer will be placed within Midland County Education Service Agency (MCESA) facilities with administrator permission. However, no participants will be directly solicited or asked to be participants. It will be up to the participants to contact the researchers based on interest in the study. Research investigators will not insinuate or directly verbalize any affiliation regarding this research study with MCESA. All 6 flyers will be promptly removed once participants request to participate in the study.

You are free to refuse the placement of flyers within the MCESA facilities. Your permission or refusal to allow placement of flyers within MCESA facilities will not affect the investigators relationships with MCESA institutions.

If you are not satisfied with the manner in which this study is being conducted, you may report (anonymously if you so choose) any complaints to the Institutional Review Board by calling 989-774-6777, or addressing a letter to the Institutional Review Board, 251 Foust Hall Central Michigan University, Mt. Pleasant, MI 48859.

My signature below indicates that all my questions have been answered. I agree to allow this investigator to place research flyers informing potential participants of the opportunity to participate in this study in MCESA facilities.

I reserve the right to view any flyers or consent forms that may be presented to potential participants. In addition, I am aware that due to confidentiality purposes, the participants' research information will not be disclosed to me or the Midland Education Service Agency without the participant's permission.

_____
Printed Name of Administrator

_____ Date Signed: _____
Signature of Administrator

A copy of this form has been given to me. _____ Administrator Initials

APPENDIX C

ADULT CONSENT FORM

CMU
CENTRAL MICHIGAN UNIVERSITY

Parent/Guardian Consent Form

Study Title: Reducing Nighttime Wakefulness in Children with Autism:
A Treatment Package Approach

Research Investigators: Karina (Livingston) Koenig, Department of Psychology: Carl Merle Johnson, Ph.D.

Contact information: 920-539-9671 or livin1km@cmich.edu:
(989) 774-6493 or johns1cm@cmich.edu

Introductory Statement

Children with Autism Spectrum Disorders who do not fall asleep easily or who wake frequently during the night are subjects of this study. As parents you will be asked to complete sleep diaries every night for a week. The sleep diaries will include the time your child fell asleep, how often your child woke during the night and what actions you took during these night wakings, what time your child woke up the next morning, mealtimes, and naptimes (if any). After about one to three weeks treatment will begin. The treatment is a combination of setting a regular schedule for mealtimes, bedtimes and naptimes, positive bedtime routines, and white noise. You will complete sleep logs every night. After about a month you will stop treatment and later we will follow-up to see how your child's sleep compares to the first week before treatment. You will complete a survey at this follow-up indicating what you like and dislike about the treatment.

What is the purpose of this study?

We are researching a combination of treatments for bedtime struggles and night waking that parents can use to reduce night time difficulties for children with autism. These are all nondrug treatments. We want to know if the treatments work in combination and as non-drug treatments.

What will my child/ward do in this study?

A combination of the following approaches will be used concurrently this study: circadian rhythm management (regular meal and bedtime schedules), positive bedtime routines, and white noise.

Circadian Rhythm Management: We will work together to establish sleep and meal schedules for your child that will comfortably fit into your family's schedules. You will complete sleep diaries every night for your child for about one week. Treatment will begin afterwards and it should last about one month.

You will be expected to follow the preset schedules every night, including weekends. These schedules will be based on your family's schedule. I will contact you about twice per week to see how your child's sleep is progressing.

Positive Bedtime Routines: We will work together to establish four to six activities that you and your child will do every night before bedtime, for example, take a bath, brush teeth and put on pajamas, get a drink, read a story, and give hugs and kisses before going to sleep in his or her bed. These positive activities should be done every night and you should praise your child after each activity in the routine. You will collect sleep diaries for about one week to three weeks and then begin one month of positive bedtime routines, still keeping sleep diaries.

White Noise: We will work together to establish a level of white noise from a white noise machine. These are similar to the sound of a fan or air conditioner. You will complete sleep diaries every night for your child for about one week to three weeks. White noise treatment will begin afterwards and it should last about one month. You will be expected to turn on the white noise every night at bedtime and turn it off in the morning, including weekends. I will contact you about twice per week to see how your child's sleep is progressing.

One month after treatment ends you will collect another week of sleep diaries and you can tell us how you like or dislike white noise in a survey.

How long will it take my child/ward to do this?

The research will last about 3 months with treatment lasting for about 1 month.

Are there any risks of participating in the study?

Initially, your child's difficulty falling asleep or staying awake at night may increase but we expect improvements after a few weeks of treatment so that he or she will experience improvements in sleep.

What are the benefits of participating in the study?

You and your child should sleep better and you will learn about different treatments that may help with bedtime struggles and night waking. This will help us determine if sleep in children with autism can be improved without the use of drugs.

Will anyone know what my child/ward does or says in this study (Confidentiality)?

A coding system will be used to keep all participant names confidential. Only Dr. Carl Johnson and I will have access to the names of the children and families.
Participant information will be kept in a locked room and will be kept for 2 years following the study.

The research findings may be presented at medical or psychological conferences and published in journals, but the only identifying characteristics will be the child's initials, age, gender, and medical conditions (for example, autism).

Will my child/ward receive any compensation for participation?

You will be paid $25 after the first week to three weeks of data collection and an additional $50 dollars will be paid for participating until the end of treatment. Another $25 dollars will be given for completing the one week follow-up.

Is there a different way for my child/ward to receive this compensation or the benefits of this study?

You can read books or research articles in journals about childhood sleep problems, but you will not be monitarily compensated for this.

Who can I contact for information about this study?

Karina (Livingston) Koenig
Livin1km@cmich.edu
(920)-539-9671

Carl Johnson, Ph.D.
johns1cm@cmich.edu
(989) 774-6493

You are free to refuse to allow your child/ward to participate in this research project or to withdraw your consent and discontinue your child/ward's participation in the project at any time without penalty or loss of benefits to which you are otherwise entitled. Your participation will not affect your child/ward's or your relationship with the institution(s) involved in this research project.

If you are not satisfied with the manner in which this study is being conducted, you may report (anonymously if you so choose) any complaints to the Institutional Review Board

by calling 989-774-6777, or addressing a letter to the Institutional Review Board, 251 Foust Hall Central Michigan University, Mt. Pleasant, MI 48859.

My signature below indicates that all my questions have been answered. I agree to allow my child participate in the project as described above.

_____ _____
Signature of Parent/Guardian Date Signed

_____
Name of Child/Ward

A copy of this form has been given to me. _____ Parent/Guardian Initials

For the Research Investigator—I have discussed with this subject the procedure(s) described above and the risks involved; I believe he/she understands the contents of the consent document and is competent to give legally effective and informed consent.

_____ _____
Signature of Responsible Investigator Date Signed

APPENDIX D

SLEEP QUESTIONAIRE

Modified ISQ

Part 1

Here are a number of questions about your child's sleeping habits. Please base your answers on what you have noticed over the last MONTH.

Office Use Only

Going to bed/sleep

How long does it usually take to settle your child to sleep on average?
(tick one box only)

[ ] less than 10 minutes
[ ] 10 to 20 minutes
[ ] 20 to 30 minutes
[ ] 30 to 40 minutes
[ ] 40 to 50 minutes
[ ] 50 to 60 minutes
[ ] 1 hour or longer

☐ 0–6

How many times a week do you have problems settling him/her on average?
(tick one box only)

[ ] Problems less than once a week
[ ] Problems 1 night a week
[ ] Problems 2 nights a week
[ ] Problems 3 nights a week
[ ] Problems 4 nights a week
[ ] Problems 5 nights a week
[ ] Problems 6 nights a week
[ ] Problems every night of the week

☐ 0–7

How long has the settling problem been going on?.....months [ ] not applicable

How many nights a week does your child wake on average?(tick one box only)

[ ] None or less than once a week
[ ] 1 night a week
[ ] 2 nights a week
[ ] 3 nights a week
[ ] 4 nights a week
[ ] 5 nights a week
[ ] 6 nights a week
[ ] Every night of the week

☐ 0–7

How many times does your child wake each night and need resettling on average? (tick one box only)

[ ] does not wake
[ ] once a night
[ ] twice a night
[ ] 3 times a night
[ ] 4 times a night
[ ] 5 or more times a night

If your child wakes, how long does it take for him/her to go back to sleep on average? (tick one box only)

[ ] less than 10 minutes
[ ] 10 to 20 minutes
[ ] 20 to 30 minutes
[ ] 30 to 40 minutes
[ ] 40 to 50 minutes
[ ] 50 to 60 minutes
[ ] 1 hour or longer

How long has the waking problem been going on?.....months [ ] not applicable

Sleeping in parents' bed

How often do you allow your child to sleep in bed with you because he/she is upset and won't sleep? (tick one box only)

[ ] Never, or less than once a week
[ ] 1 night a week
[ ] 2 nights a week
[ ] 3 nights a week
[ ] 4 nights a week
[ ] 5 nights a week
[ ] 6 nights a week
[ ] Every night of the week

How long has the problem been going on?.....months [ ] not applicable.

Part 2: Your views

Do you think that your child has sleeping difficulties?

[ ] no
[ ] yes, mild
[ ] yes, moderate
[ ] yes, severe

Office Use Only

☐ 0–5

☐ 0–6

☐ 0–7

Total Score

☐ 0–38

Maternal Criteria

☐ Yes

☐ No

Office Use Only

Research Criteria

A settling or waking problem occurring 5 or more nights per week and of 2 or more months duration plus 1 or more of the following:

i) Taking greater than 30 minutes to settle.
ii) Waking 3 or more times per night.
iii) Waking for greater than 20 minutes during the night.
iv) Sleeping in the parental bed because upset and won't sleep 3 or more times per week.

Research Criteria

☐ Yes

☐ No

APPENDIX E

SLEEP DIARY

Sleep Diary

Child:_____ Month:_____

Day:_____

Time of waking	
Did the child awake on his/her own?	
Any problems waking? If yes, please describe.	
Does he/she take a daytime nap? If yes, please provide time and length of nap	
Time of meals	Breakfast: Lunch: Dinner:
Time he/she was put to bed at night	
Time he/she actually fell asleep (indicated by silence)	
Were there problems going to bed/getting off to sleep? Please describe, including what you did, what your child did, and how he/she eventually fell asleep	
Number and length of night wakings. Please describe why he/she woke (if known), what you did and how he/she eventually went back to sleep	
Any unusual circumstances (e.g. vacation, changes in medication, illness)	

APPENDIX F

TREATMENT INTEGRITY CHECK

Treatment Integrity Checklist

Child:_____ Month:_____

Day:_____

Did you complete the sleep diary today?	Yes	No
Did you record:		
Wake time?	Yes	No
Meal times?	Yes	No
Nap times (if any)?	Yes	No
Bedtime?	Yes	No
Time child fell asleep?	Yes	No
Did you follow the daily schedule for the following:		
Wake time?	Yes	No
Mealtimes?	Yes	No
Nap time (if any)?	Yes	No
Bedtime?	Yes	No
Did you follow the bedtime routine? 1st behavior: _____ 2nd behavior: _____ 3rd behavior: _____ 4th behavior: _____ 5th behavior: _____ 6th behavior: _____	Yes Yes Yes Yes	No
Did you use the white noise machine?	Yes	No
Did you record the number of night wakings and the length of duration?	Yes	No
Did you record any difficulties the child had in going to sleep?	Yes	No

APPENDIX G

SOCIAL VALIDITY QUESTIONAIRE

Treatment Acceptability Survey

Child:_____ Month:_____

Day:_____

Please circle the number which most closely approximates your agreement with the following statements:

1= Strongly Agree (SA), 3=Neutral (N), 5= Strongly Disagree (SD), N= Not Sure

	SA N SD
The bedtime, meal time, nap time, and wake time schedules used during treatment fit into our family's regular schedule.	1 2 3 4 5 N
The use of bedtime routines during this treatment were appropriate to help my child to prepare for bed.	1 2 3 4 5 N
The use of white noise during this treatment was appropriate to help my child fall asleep or stay asleep longer. indicate which one/ones:_____	1 2 3 4 5 N
The treatment was appropriate for my child.	1 2 3 4 5 N
The treatment was described in an understandable way.	1 2 3 4 5 N
Implementing the treatment was within my skill level.	1 2 3 4 5 N
The results obtained from the treatment were beneficial enough to warrant the amount of effort that it took to implement and maintain the treatment.	1 2 3 4 5 N
The treatment reduced my child's night time difficulties.	1 2 3 4 5 N
I would use one or more of the three approaches of this treatment again.	1 2 3 4 5 N
I would recommend one or more of the three approaches of this treatment to others. Please indicate which one/ones?_____	1 2 3 4 5 N

What did you like most about the treatment?

What did you like least about the treatment?

Are there any aspects of the treatment that you would change?

REFERENCES

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

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1 (1),* 91-97.

Banks, S., & Dinges, D. (2007). Sleep and circadian control of neurobehavioral functions. *Neuroergonomics: The Brain at Work, 430,* 207-220. doi:10.1093/acprof:oso/9780195177619.001.0001

Baranek GT. (2002). Efficacy of sensory and motor interventions for children with autism. *Journal of Autism and Developmental Disorders, 32,* 397-422.

Bates, J.E., Viken, R.J., Alexander, D.B., Beyers, J., & Stockton, L. (2002). Sleep and adjustment in preschool children: sleep diary reports by mothers related to behavior reports by teachers. *Child Development, 73*, 62-74.

Barlow, D.H., Nock, M.K., & Hersen, M. (2008). *Single subject designs: Strategies for studying behavior change* (3rd ed.). Boston, MA: Allyn & Bacon Inc.

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

Brackbill, Y. (1970). Acoustic variation and arousal level in infants. *Psychophysiology, 6,* 517-526.

Brackbill, Y. (1971). Cumulative effects of continuous stimulation on arousal level in infants. *Child Development. 42 (1),* 17-26.

Brackbill, Y. (1973). Continuous stimulation reduces arousal level: stability of the effect over time. *Child Development, 44 (1),* 43-46.

Bradley-Johnson, S. (2007). Gilliam Autism Rating Scale-Second Edition (GARS-2) 2006 test review (Unpublished test review of *Gilliam autism scale-second edition*. Austin, TX: PRO-ED). Central Michigan University, Michigan.

Borkowski, M., Hunter, K., & Johnson, C. M. (2001). White noise and scheduled bedtime routines to reduce infant and childhood sleep disturbances. *The Behavior Therapist, 24,* 29-47.

Buysse, D. J., Germain, A., Moul, D., & Nofzinger, E. A. (2005). Insomnia. *FOCUS: The Journal of Lifelong Learning in Psychiatry, 3,* 568-584.

Courchesne, E., Redcay, E., Morgan, J., & Kennedy, D. (2005). Autism at the beginning: Microstructural and growth abnormalities underlying the cognitive and behavioral phenotype of autism. *Development and Psychopathology, 17,* 577-597.

Czeisler, C. A. (1980). Human sleep: Its duration and organization depend on its circadian phase. *Science, 210,* 1264-1267.

Christodulu, K., & Durand, 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.

Dahl, R. E., Pelham, W. E., & Wierson, M. (1991). The role of sleep disturbances in attention deficit disorder symptoms: A case study. *Journal of Pediatric Psychology, 16,* 229-239.

Donaldson, D. L., & Owens, J. A. (2006). Sleep and sleep problems. In G.G. Bear & K. M. Minke (Eds). *Children's needs III: Development, prevention, and intervention*. Pp. 1025-1039. Bethesda, MD: National Association of School Psychologists.

Dijk, D., & Czeisler, C. (1995). Contribution of the circadian pacemaker and the sleep hemostat to sleep propensity, sleep structure, electroencephalographic slow waves, and sleep spindle activity in humans. *The Journal of Neuroscience,* 15, 3526-3538.

Ferber, R. (2006). *Solve your child's sleep problems*. New York, NY: Fireside.

Forquer, L. M. (2006). The effects of continuous white noise on sleep patterns, moods, and cognitive performance of college students. *Dissertations Abstracts International, 67,* 3221061.

Forquer, L. M., & Johnson, C. M. (2005). Continuous white noise to reduce resistance going to sleep and night wakings in toddlers. *Child & Family Behavior Therapy, 27 (2),* 1-10.

Forquer, L. M., & Johnson, C. M. (2007). Continuous white noise to reduce sleep latency and night wakings in college students. *Sleep and Hypnosis, 9 (2),* 60-66.

Fuller, P.M., Gooley, J.J., Saper, C.B. (2006). Neurobiology of the Sleep-Wake Cycle: Sleep Architecture, Circadian Regulation, and Regulatory Feedback. *Journal of Biological Rhythms,* 21, 482-493.

Gilliam, J. E. (1995). *Gilliam autism scale*. Austin, TX: PRO-ED.

Gilliam, J. E. (2006). *Gilliam Autism Rating Scale-Second Edition.* Austin, TX: PRO-ED.

Giannotti, F., Cortesi, F., Cerquiglini, A., & Bernabei, P. (2006) An open-label study of controlled-release melatonin in treatment of sleep disorders in children with autism. *Journal of Autism and Developmental Disorders,* 36, 741-752.

Gillham, J. E., Carter, A.S., Volkmar, F. R., & Sparrow, S.S. (2000). Toward a developmental operational definition of autism. *Journal of Autism and Developmental Disorders,* 30, 269-278.

Glickman, G. (2010). Circadian rhythms and sleep in children with autism. *Neuroscience and Biobehavioral Reviews, 34,* 755-768.

Goldman, S.E., Richdale, A.L., Clemons, T., & Malow, B.A. (2012). Parental sleep concerns in autism spectrum disorders: Variations from childhood to adolescence. *Journal of Autism and Developmental Disorders,42,* 531-538.

Hall, G. B. C., West, D., & Szatmari, P. (2007). Backward masking: Evidence of reduced subcortical amygdala engagement in autism. *Brain and Cognition, 65 (1),* 100–106.

Hare, D.J., Jone, S.H. & Evershed, K.(2006a). A comparative study of circadian rhythm functioning and sleep in people with Asperger syndrome. *SAGE publications and the National Autistic Society* 10, 565-575.

Hare, D.J., Jone, S.H. & Evershed, K. (2006b). Objective investigation of the sleep–wake cycle in adults with intellectual disabilities and autistic spectrum disorders. *SAGE publications and the National Autistic Society* 50, 701-710.

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

Johnson, C. M., & Lerner, M. (1985). Amelioration of infant sleep disturbances: II. Effects of scheduled awakenings by compliant parents. *Infant Mental Health Journal, 6,* 21-30. doi: 10.1002/1097-0355(198521)6:1<21::AID-IMHJ2280060105>3.0.CO;2-Q

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child,* 2, 217-250.

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

Kazdin, A. & Kopel, S. (1975). On resolving ambiguities of the multiple-baseline design: Problem and recommendations. *Behavior Therapy, 6,* 601-608.

Knight, R.M. & Johnson, C.M. (2013). Using a behavioral treatment package for sleep problems in children with autism spectrum disorders. Retrieved from Central Michigan University. (HQ8x K652)

Kuhn, B. & Weidinger, D. (2000). Interventions for infant and toddler sleep disturbance: A review. *Child & Family Behavior Therapy, 22 (2),* 33-50.

Lawton, C., France, K., & Blampied, N. (1991). Treatment of infant sleep disturbances by graduated extinction. *Child & Family Behavior Therapy, 13 (1),* 39-56.

Lecuyer, E., & Houck, G.M. (2006). Maternal limit-setting in toddlerhood: Socialization strategies for the development of self-regulation. *Infant Mental Health Journal, 27,* 344-370.

Lovaas, O. I., Koegel, R., Simmons, J. Q., & Long, J. S. (1973). Some generalization and follow-up measures on autistic children in behavior therapy. *Journal of Applied Behavior Analysis, 6 (1),* 131-166.

Lovaas, O. I., & Wilhelm, H. (1976). Stimulus over selectivity: A common feature in autism and mental retardation. *American Journal of Mental Deficiency, 81 (1),* 26-31.

Lozoff, B., & Zuckerman, B. (1988). Sleep problems in children. *American Academy of Pediatrics, 10 (1),* 17-24.

Meltzer, L. (2008). Brief report: Sleep in parents of children with autism spectrum disorders. *Journal of Pediatric Psychology, 33,* 380-386.

Meltzer, L. & Mindell, J. (2006). Sleep and sleep disorders in children and adolescents. *Psychiatric Clinics of North America, 29,* 1059-1076.

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, 29,* 1263-1276.

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

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

Montgomery, J. M., Newton, B., & Smith, C. (2008). Test review: Gilliam Autism Rating Scale-Second Edition (Test review of *Gilliam autism scale-second edition*). Austin, TX: PRO-ED). *Journal of Psychoeducational Assessment, 26,* 395-401.

Morrell, J. M. B. (1999). The infant sleep questionnaire: A new tool to assess infant sleep problems for clinical and research purposes. *Child Psychology & Psychiatry Review, 4 (1),* 20-26.

Moon, E.C., Corkum, P. & Smith, M. (2011). Case study: A case-series evaluation of behavioral sleep intervention for three children with autism and primary insomnia. *Journal of Pediatric Psychology,* 36, 47-54.

Moore, P.S. (2004). The use of social stories in a psychology service for children with learning disabilities: a case study of a sleep problem. *British Journal of Learning Disabilities,* 32, 133-138. doi: 10.1111/j.1468-3156.2004.00278

Owens, J. (2004). Services and programs proven to be effective in managing infant/child sleeping disorders and their impact on the social and emotional development of young children. In *Encyclopedia on Early Childhood Development* online. Retreived from http://www.child-encyclopedia.com/documents/OwensJANGxp.pdf

Owens, J., France, K., & Wiggs, L. (1999). Behavioral and cognitive-behavioral interventions for sleep disorders in infants and children: A review. *Sleep Medicine Reviews, 4,* 281-302.

Piazza, C. C., Hagopian, L. P., Hughes, C. R., & Fisher, W. W. (1998). Using chronotherapy to treat sever sleep problems: A case study. *American Journal of Mental Retardation, 102,* 358-366.

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.

Ramchandani, P., Wiggs, L., Webb, V., & Stores, G. (2000). A systematic review of treatments for settling problems and night waking in young children. *British Medical Journal, 320,* 209-213.

Richdale, A.L. (1999). Sleep problems in autism: prevalence, cause, and intervention. *Developmental Medicine & Child Neurology*, 41, 60–66. doi: 10.1111/j.1469-8749.1999.tb00012

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

Rincover, A. (1978). Variables affecting stimulus fading and discriminative responding in psychotic children. *Journal of Abnormal Psychology, 87,* 541-553.

Robinson, D. H., Fouladi, R., & Williams, N. (2002). Some effects of effect size and "What if" information. *Journal of Experimental Education, 70,* 365-382.

Rossignol,D.A., Frye, R.E. (2011). Melatonin in autism spectrum disorders: a systematic review and meta-analysis. *Developmental Medicine & Child Neurology,* 53, 783-792.

Sadeh, A., Gruber, R., & Raviv, A. (2003). The effects of sleep restriction and extension on school-age children what a difference an hour makes. *Child Development, 74,* 444-455.

Sajith, S.G., & Clarke, D. (2007). Melatonin and sleep disorders associated with intellectual disability: A clinical review. *Journal of Intellectual Disability Research, 51 (1),* 2-13.

Sakakini, R.J. (2011). Behavioral treatments for sleep problems in youth: A meta-analytic review. (Doctoral dissertation). Retrieved from ProQuest Digital Dissertations. (3452590).

Schmidt, K. (1975). The effect of continuous stimulation on the behavioral sleep of infants. *Merrill-Palmer Quarterly, 21,* 77-88.

Schreck, K. A. (2001). Behavioral treatments for sleep problems in autism: Empirically or just universally accepted. *Behavioral Interventions, 16,* 265-278. doi: 10.1002/bin.98

Schreck, K.A., & Mulick, J.A. (2000). Parental report of sleep problems in children with autism. *Journal of Autism and Developmental Disorders*, 30, 127–135.

Schreck, Mulick, and Smith (2004). Sleep problems as possible predictors of intensified symptoms of autism. *Research in Developmental Disabilities*, 25 (1), 57-66.

Schreibman, L. (1975). Effects of within-stimulus and extra-stimulus prompting on discrimination learning in autistic children. *Journal of Applied Behavior Analysis, 8 (1),* 91-112. doi: 10.1901/jaba.1975.8-91

Souders, M. C., Mason, T. B. A., Valladares, O., Bucan, M., Levy, S. E., Mandell, D. S., Weaver, T. E., & 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.

Spencer, J. A., Moran, D. J., Lee, A., & Talbert, D. (1990). White noise and sleep induction. *British Medical Journal, 65,* 135-137.

Tudor, M.E., Hoffman, C.D., & Sweeny, D.P. (2012). Children with autism: Sleep problems and symptom severity. *Focus on Autism and Other Developmental Disabilities, 27,* 254-262. doi: 10.1177/1088357612457989

Vriend, J.L., Corkum, P., Moon, E.C., & Smith, I. M. (2011). Behavioral interventions for sleep problems in children with autism spectrum disorders: Current findings and future directions. *Journal of Pediatric Psychology*, 36, 1017-1029.

Weiskop,S., Richdale, A., & Mathews, J. (2005). Behavioural treatment to reduce sleep problems in children with autism or fragile X syndrome. *Developmental Medicine & Child Neurology,* 47, 94-104. doi: 10.1111/j.1469-8749.2005.tb01097.x

Weissbluth, M. (1982). Modification of sleep schedule with reduction of night waking: A case report. *Journal of Sleep Research & Sleep Medicine, 5,* 262-266.

Wiggs, L., & Stores, G. (2004). Sleep patterns and sleep disorders in children with autistic spectrum disorders: Insights using parent report and actigraphy, *Developmental Medicine & Child Neurology,* 46, 372–380.

Wiggs, L., & Stores, G. (1998). Abnormal sleep patterns associated with autism. *Autism,* 2, 157-169. doi: 10.1177/1362361398022004

Wiggs, L., & Stores, G. (1996). Sleep problems in children with severe intellectual disabilities: What help is being provided? *Journal of Applied Research in Intellectual Disabilities, 92,* 160-165.

Williamson, J. W. (1992). The effects of ocean sounds on sleep after coronary artery bypass graft surgery. *American Journal of Critical Care, 1(1),* 91-97.

Wing, L. (1981). Asperger's syndrome: A clinical account. *Psychological Medicine, 11 (1),* 115-129.