Evaluation of a Telehealth Parent Training Program for Parents of Children with Autism Spectrum Disorder and Sleep Difficulties

Aman-Preet Kaur Randhawa, M.ADS (ABA Specialization)

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Faculty of Social Sciences, Brock University

St. Catharines, Ontario

Abstract

Many children with autism spectrum disorder (ASD) experience some form of sleep difficulty (e.g., delayed sleep onset, unwanted co-sleeping, prolonged or frequent night wakings). Although research supports parent-implemented behaviour-analytic sleep interventions to address sleep difficulties in children with ASD (e.g., Jin et al., 2013; Linnehan et al., 2022), more research is needed to determine how accurately parents implement behavioural sleep interventions and the effectiveness of parent training and coaching via telehealth. The present study used a concurrent multiple baseline across participants design to evaluate parents' ability to implement their child's behaviour-analytic sleep intervention (i.e., treatment fidelity) and a pre-/post-test design to evaluate parents' ability to monitor and make decisions related to their child's sleep (i.e., decision-making accuracy). Parent stress levels were evaluated pre- and post-intervention using the Parenting Stress Index 4th Edition Short Form (PSI-4-SF; Abidin, 2012). Child sleep-related outcomes (e.g., sleep onset delay, occurrences of sleep-interfering behaviours, and total sleep duration) were also monitored. Four parent-child dyads participated; mothers were the primary parent participants. Parents received behavioural skills training and nighttime coaching, via telehealth, over a 12-week intervention period. Overall, results indicate that parents' treatment fidelity remained high throughout intervention (i.e., $\geq$80%). Further, parents' decision-making accuracy increased from pre-test to post-test and remained at post-test levels during intervention. Two of four parents returned the PSI-4-SF. Results indicate that the intervention did not increase or decrease parent stress levels. Additionally, sleep onset delay decreased for two of four child participants. Occurrences of sleep-interfering behaviours remained variable for all child participants. Total sleep duration increased for two of four child participants. All three children who were co-sleeping at the start of the study were sleeping

independently by the end of the study. All parents rated the sleep intervention as positive and acceptable. Strengths, limitations, and areas for future research are discussed.

Keywords: parent training, parent coaching, treatment fidelity, behavioural sleep intervention, telehealth

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“own”, so their willingness to learn and implement a sleep intervention–with fidelity–is truly extraordinary.

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Evaluation of a Telehealth Parent Training Program for Parents of Children with Autism Spectrum Disorder and Sleep Difficulties

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction as well as repetitive and restricted behaviours (American Psychiatric Association, 2013). According to the Public Health Agency of Canada (2018), 1 in 66 children, aged 5 to 17 years old, have been diagnosed with ASD. Of children diagnosed with ASD, high prevalence rates of sleep problems have been found (i.e., 40-80%; Fadini et al., 2015; Köse et al., 2017; Mindell & Meltzer, 2008; Reynolds & Malow, 2011) compared to prevalence rates of sleep problems in children with typical development (9-50%; Köse et al., 2017; Reynolds & Malow, 2011). The National Sleep Foundation recommends that children aged 3 to 5 years old, sleep between 10 and 13 hrs a night, and children aged 6 to 13 years old, sleep between 9 and 11 hrs a night (Hirshkowitz et al., 2015).

Parents of children with ASD are more likely to report sleep problems than parents of children with typical development (Reynolds et al., 2018). Common sleep problems include long sleep onset delays (i.e., how long it takes children to fall asleep), inappropriate or unhealthy sleep dependencies (e.g., unwanted co-sleeping, screen time before bed), sleep-interfering behaviours (e.g., crying, tantrums, requests to sleep with parents), frequent or prolonged night wakings, restless sleep, early morning awakenings, and difficulty waking or daytime sleepiness (Cohen et al., 2014; Reynolds & Malow, 2011; Richdale & Schreck, 2009; Rigney et al., 2018). Often, these sleep problems co-occur for children with ASD and if not adequately addressed, these problems may persist for several years (Cohen et al., 2014; Mindell et al., 2006; Mindell & Meltzer, 2008; Richdale & Schreck, 2009; Sadikova et al., 2022).

Overall, sleep supports mental and physical wellbeing (Cohen et al., 2014). In fact, childhood sleep disturbances may be linked to adaptive functioning deficits (Cohen et al., 2014) and low health-related quality of life (Delahaye et al., 2014). Further, sleep problems may exacerbate core ASD symptoms (Cohen et al., 2014; Reynolds & Malow, 2011). Shorter sleep durations may also be linked to high rates of stereotypic behaviours (MacDuffie et al., 2020), social skill deficits, and impairments in communication (Cohen et al., 2014; Reynolds & Malow, 2011). Diminished sleep may also be associated with high rates of challenging behaviours (i.e., non-compliance, aggression, disruption; Cohen et al., 2014; Johnson et al., 2018).

Families of children with ASD may also experience higher stress levels than families of children without ASD (Padden & James, 2017). These stress levels may be exacerbated when children with ASD experience sleep difficulties as parents often report experiencing daily stress and difficulty managing their child's sleep problems (Hodge et al., 2013; Reynolds & Malow, 2011). Further, parents of children with ASD have reported poor health-related quality of life compared to the general population (Kuhlthau et al., 2014) and more specifically, female caregivers of children with ASD have reported poor health-related quality of life compared to the general female population (Khanna et al., 2010). Given the pervasive nature of sleep problems and the negative impact of sleep problems on parental stress levels as well as child and family quality of life, interventions that improve sleep are critical.

Behavioural Sleep Assessment and Intervention

Assessment

Behaviour analytic approaches to address sleep difficulties include both assessment and intervention components. Assessment involves gathering information about the nature of sleep problems, the child's sleep history, and the impact of sleep problems on both the child and

family. Assessments typically include a combination of indirect measures (e.g., questionnaires, interviews, sleep logs) and direct measures (e.g., continuous video recording, actigraphy, motion and sound detection; McLay et al., 2020).

For example, Jin et al. (2013) used the Sleep Assessment and Treatment Tool (SATT; Hanley, 2005), direct video observation, and parent sleep logs to assess the nature of participants' sleep difficulties and relevant environmental factors to guide the creation of an individualized behavioural sleep intervention for three children; two of whom were diagnosed with ASD. The SATT is a form of a functional behaviour assessment (FBA) conducted in an open-ended interview format with caregivers. The SATT identifies the idiosyncratic environmental variables that influence and maintain sleep challenges; it explores the history of the child's sleep difficulties, antecedents and consequences associated with relevant sleep interfering behaviours, and the child's current sleep schedule and sleep dependencies (Jin et al., 2013). Video recordings captured children's sleep-wake activity for 30% of nights and were used to corroborate the information obtained from parent sleep logs. Parents recorded the bid goodnight time, fall asleep time, morning wake time, the time of night awakenings and if the child fell asleep again, and any naps that occurred. Results of the SATT in the Jin et al. study identified various functions maintaining children's sleep-interfering behaviours (e.g., socially-mediated positive reinforcement in the form of access to tangibles [e.g., books, magazines, papers] and socially-mediated positive reinforcement in the form of attention).

Consistent with Jin et al., McLay et al. (2019b) conducted a pre-assessment clinical interview, SATT, parent-recorded sleep logs, and videosomnography to assess the nature of their participants' sleep problems. During the clinical interview, researchers collected information from parents about the environment, history of sleep challenges, child's developmental history,

and the family context. On the sleep log, parents recorded the frequency, duration, and setting of daytime naps, the setting and time their child was put to bed, the frequency of curtain calls (i.e., children leaving the bed to find their parents) and child behaviour during curtain calls, the frequency and duration of night wakings, and morning awake time. Parents also reported their responses each time their child exhibited sleep challenges during sleep onset and night wakings. A nighttime, infrared video camera was also placed in children's bedrooms to collect data on sleep outcome measures for 30% of nights; however, no audio was captured in these recordings. The FBA, consisting of the SATT, sleep logs, and videosomnography, identified multiple functions maintaining sleep challenges for each child. They found that socially-mediated positive reinforcement in the form of attention maintained co-sleeping, socially-mediated positive reinforcement in the form of access to tangibles (e.g., preferred items, toys, or milk) maintained sleep-interfering behaviours, and for three of the seven children, negative reinforcement in the form of escape from bed or sleeping alone maintained leaving the bed. Other variables that appeared to impact sleep included the absence of biological sleep pressure (i.e., the need to sleep) due to delayed sleep onset or daytime napping, and sensory input in the form of whispering and environmental noise. As such, the FBA revealed multiple functions and idiosyncratic environmental variables that impacted sleep for each child. A limitation of this study was that the authors did not evaluate the accuracy of data collected through parent-reported sleep logs.

Intervention

Results from the previously described indirect and direct assessments are then used to inform the development of individualized sleep interventions. There is a substantial body of evidence supporting behavioural interventions to effectively resolve sleep problems and increase

children's total sleep duration (Ashbaugh & Peck, 1998; Jin et al., 2013; McLay et al., 2019b; McLay et al., 2020; McLay et al., 2021; Mindell et al., 2006; Mindell & Meltzer, 2008; Piazza & Fisher, 1991; Sanberg et al., 2018; van Deurs et al., 2021). To achieve these outcomes, behavioural sleep interventions often combine multiple behaviour-change strategies, such as but not limited to, reinforcement, extinction, sleep hygiene, faded bedtime, systematic fading of parental presence, progressive waiting, and bedtime pass. These behaviour-change strategies are ideally based on the results of a functional assessment, but not always (e.g., Ashbaugh & Peck, 1998; Piazza & Fisher, 1991).

Reinforcement. Reinforcement involves an immediate stimulus change following a response that increases the future likelihood of that response under similar conditions (Cooper et al., 2020). Reinforcement may be systematically used to increase appropriate sleep behaviours (e.g., child stays in bed after bid goodnight, child stays asleep in their bed overnight). For sleep interventions, reinforcement often involves providing access to a tangible or social reward each morning, contingent on the child sleeping in their own bed for the night in the absence of sleep-interfering behaviours.

Extinction. Extinction involves withholding reinforcement for a previously reinforced behaviour (Cooper et al., 2020). Extinction may be systematically applied to decrease the occurrence of sleep-interfering behaviours. For sleep interventions, extinction involves identifying the consequences maintaining the sleep interfering behaviour and then changing these consequences (e.g., if parents generally provided attention to their child following the occurrence of sleep interfering behaviour, this would be discontinued; if a child was given more time with a preferred activity, this would be discontinued). Extinction is typically used in combination with other reinforcement-based strategies. Extinction typically takes two forms: (1)

with the parent out of the room and not attending to the child after the bid goodnight (i.e., unmodified extinction) or (2) with the parent in the room and offering a level of comfort to the child (based on distance) but no other interaction (i.e., modified extinction with parental presence; Honaker & Meltzer, 2014).

Sleep Hygiene. Sleep hygiene involves healthy practices that are regularly completed prior to bed in order to improve the child's sleep and wake cycle (Abel et al., 2017). This involves establishing regular nighttime routines that relax and prepare the child for sleep and establishing regular daytime routines that support sleep at night (i.e., establishing stimulus control for sleep). This may include identifying activities that stimulate versus relax the child; it is recommended that activities that stimulate the child (e.g., exercise, watching television) are completed up to 1 hr before the designated bedtime and activities that relax the child (e.g., reading books, completing puzzles) are completed in the hour leading up to bedtime (Abel et al., 2017; Jan et al., 2008). Other ways to improve sleep hygiene include consistently putting the child to bed at the same time each night, consistently waking the child up at the same time each morning, and creating an optimal sleep environment (Jan et al., 2008). There should not be more than a 1 hr difference between wake and sleep times each morning and night (Jan et al., 2008). Further, optimal sleep environments may include minimizing light exposure from sources within the room (e.g., lamps, nightlights) and outside the room (e.g., streetlights). In some instances, the bed may need to be repositioned to minimize light exposure during the night. Although improving sleep hygiene practices is often the first step taken to address sleep problems, it may be insufficient for addressing severe sleep problems (Abel et al., 2017; Jan et al., 2008). For this reason, strategies aimed at improving sleep hygiene are typically incorporated with other behavioural strategies.

Faded Bedtime. Faded bedtime is an antecedent strategy that addresses difficulties with sleep onset (i.e., delayed sleep onset) and the occurrence of sleep-interfering behaviours. Faded bedtime involves systematically delaying a child's bedtime based on their natural sleep onset time (Mindell et al., 2006; Piazza & Fisher, 1991). Delaying bedtime helps ensure the time between when the child is put to bed and when they fall asleep remains short; this allows for smoother transitions and may prevent the occurrence of sleep-interfering behaviours (Mindell et al., 2006). Further, it may help establish stimulus control between the bedroom, the bedtime routine, and sleep behaviour, thus preventing or reducing the occurrence of sleep-interfering behaviours. Once the child has fallen asleep within 15 to 20 mins of this new time, the bedtime can begin to move forward. The bedtime continues to move forward systematically until the desired bedtime is reached.

Faded bedtime may also include response cost strategies. This involves removing the child from their bed for a pre-determined time if they do not fall asleep (Mindell et al., 2006; Piazza & Fisher, 1991). Following the pre-determined time of removal from bed, the child is then placed back in bed (Piazza & Fisher, 1991). If the child is not asleep within 15 mins, then the child is removed again–this cycle repeats until the child falls asleep within 15 mins.

Systematic Fading of Parental Presence. If parents identify co-sleeping with their child as problematic, children may be taught to tolerate their parent's absence during sleep onset and/or overnight (i.e., during night wakings). Parents are taught to systematically fade themselves out of their child's bed and bedroom. Depending on the results of the child's assessment, this may initially involve the parent sitting on a chair or sleeping on a mattress in the child's bedroom. Once the child is successful at the current step, the parent begins to systematically move their chair or mattress further from the child's bed, until they are out of the

room and back to sleeping in their own bed. This strategy is typically used in combination with extinction (described above; McLay et al., 2019b).

Progressive Waiting. Progressive waiting–also known as graduated extinction–is a procedure that involves visiting the child on a predetermined schedule until they fall asleep and then extending the intervals between visits based on the child's behaviour (Honaker & Meltzer, 2014). If the child engages in sleep-interfering behaviour, the parent does not provide any attention but re-starts the timer for the designated period of time before visiting the child again. During each visit, the parent provides brief (i.e., 30 secs) attention to their child and leaves the bedroom. This cycle repeats until the child falls asleep.

Bedtime Pass. The bedtime pass is a procedure whereby the child is given a pass that may be used for one request to leave the bedroom (Friman et al., 1999). The child can only request for one action to be completed in exchange for one bedtime pass. The request should be for something brief, such as getting a hug, using the bathroom, or answering a question. Once the request is granted, the bedtime pass is taken away until the following night. Over time, children may not use the pass or save it for an emergency (e.g., there is a monster in their room, and they need a hug). If any other sleep-interfering behaviours occur following the exchange of the bedtime pass, parents would use extinction (described above).

Multi-Component Interventions. Sleep interventions typically involve a combination of the above-described assessment and behaviour-change strategies. For example, Jin et al. (2013) evaluated the impact of an individualized multi-component (i.e., consisting of at least two single behaviour-change strategies) behavioural sleep intervention. Common sleep problems included delayed sleep onset, frequent night wakings or early morning awakenings, and sleep-interfering behaviours. Common goals for parents included reducing their child's sleep onset delay to 30

mins or less, achieving an age-appropriate amount of sleep, and eliminating sleep-interfering behaviours. Individualized intervention packages included several behaviour-change strategies such as improving sleep hygiene practices, faded bedtime, systematic fading of parental presence out of the bed and bedroom, extinction, and reinforcement. For all children, sleep onset delay reduced to 30 mins or less, the duration of night wakings decreased, and sleep-interfering behaviours reduced to near-zero levels. These improvements generally maintained at follow-up. Finally, all children achieved an age-appropriate amount of sleep and parent-identified sleep goals were achieved. Parents also reported high levels of satisfaction with the intervention components.

Similar to Jin et al., McLay et al. (2019a) assessed the effect of an individualized multi-component intervention for two children, aged 4 and 10 years old with ASD. Both participants frequently engaged in curtain calls and frequent and prolonged night wakings. The second participant engaged in unwanted co-sleeping; during sleep onset, the child fell asleep in her own bed, but during night wakings, the child would wake up and go to her parent's bedroom and remain there for the rest of the night. Each child's multi-component intervention consisted of a variety of behaviour-change strategies including establishing a consistent bedtime routine, reinforcement, extinction, visual aids, white noise, and a social story. For both participants, sleep onset delay decreased from baseline (though one participant's sleep onset was outside the ideal range), frequency of curtain calls and night wakings decreased as well as the duration of night wakings (i.e., how long children were up at night). Finally, parents rated the individualized multi-component intervention as acceptable.

Sleep Interventions via Telehealth

Broadly defined, telehealth is a service delivery format in which distance technology (e.g., videoconferencing) is used, synchronously or asynchronously, to provide individuals with access to education and intervention (Gerow et al., 2021b; McLay et al., 2020). Telehealth has many advantages including (a) service provision to rural and remote communities, (b) reduces the impact on the environment as there is no need to travel, (c) represents a time and cost efficient approach, (d) allows for "real-time" monitoring of parent coaching, (e) provides an opportunity to directly evaluate progress, and (f) can be used during unprecedented events (i.e., COVID-19 pandemic) in order to avoid service disruptions (Lee et al., 2015; McLay et al., 2020; Tomlinson et al., 2018). On the other hand, the challenges of telehealth include (a) the potential cost to set up and maintain equipment, (b) difficulties with setting up and operating equipment, (c) equipment malfunction, (d) limited camera visibility, (e) a hands-off approach, and (f) connection difficulties that may impact service delivery (Lee et al., 2015; McLay et al., 2020; Tomlinson et al., 2018). Given the recent proliferation of cost-effective telehealth technologies (e.g., Zoder-Martell et al., 2020), and the ubiquitous nature of applications such as Facebook and Zoom, the potential benefits of addressing sleep problems via telehealth offset the challenges.

Overall, telehealth-delivered sleep interventions have received limited attention in the literature. McLay et al. (2020) completed a systematic review of telehealth and behavioural-based interventions to address sleep problems in children and adolescents; four studies included children with ASD or attention deficit hyperactivity disorder. Overall, the studies reported positive outcomes related to children's sleep (e.g., sleep onset delay, total sleep duration, and sleep-interfering behaviours); however, only five of the ten studies included were reported to have strong methodological rigor. Results should be interpreted with this limitation in mind. Further, only one of the studies included in the review used a single-case research design; the

rest of the studies used a between-group design. This finding suggests that there is a need to assess the impact of telehealth-delivered sleep interventions using single-case research designs as these designs allow experimenters to demonstrate functional relations between the behaviour and the environment (Cooper et al., 2020). One example of this includes Lichtblau et al. (2018) who demonstrated the effectiveness of a remote monitoring and telehealth-delivered intervention to address sleep-related trichotillomania and trichophagia of a 3-year-old child with ASD. Although the participant's overall sleep increased and problem behaviours decreased, this study is limited by the fact that the researchers did not collect parent treatment fidelity data.

Additionally, McLay et al. (2021) conducted a case analysis of 41 children and adolescents receiving a function-based behavioural intervention to address sleep problems; they found no difference in sleep intervention outcomes between services delivered in-person versus telehealth. Further, there were no statistically significant differences in treatment acceptability scores between those who received services in-person and telehealth. These findings provide emerging support for the delivery of sleep services via telehealth.

Training and Treatment Fidelity

As behavioural sleep interventions are often implemented by parents an important consideration for sleep intervention is how best to train parents to implement interventions. In fact, the success of behavioural interventions depends on the accurate and consistent implementation of the procedures both within the training environment and the participant's natural environment (Allen & Warzak, 2000; Falakfarsa et al., 2021; Fryling et al., 2012; McIntyre et al., 2007). As such, training individuals to implement interventions accurately is important. Two of the most common training approaches include behavioural skills training (BST) and coaching.

Behavioural Skills Training

Behavioural skills training is an evidence-based approach to training (Parsons et al., 2012). Behavioural skills training involves a) describing the target skill, b) providing a written description of the skill and rationale for the skill, c) modelling the target skill, d) rehearsal of the target skill, e) providing supportive and corrective feedback during practice, and f) repeating steps d and e until a predetermined mastery criterion has been reached (Parsons et al., 2012). Although Parsons et al. (2012) suggest setting a BST session mastery criterion of 100% or a lower percentage with prespecified items that must be performed with 100% accuracy, others have set their mastery criterion between 80%–90% over a minimum number of trials or sessions (e.g., Dogan et al., 2017; Ward-Horner & Sturmey, 2008).

A BST model has been successfully used to teach caregivers with varying levels of education and experience to implement a range of assessments and interventions (e.g., Clay et al., 2021; Miles & Wilder, 2009). Further, BST may be conducted with (e.g., Miles & Wilder, 2009) or without the child present (e.g., Nuta et al., 2021; Treszl et al., 2021); however, training sessions without the child present may be more practical for parents. The nature of models and role-plays may also differ amongst studies. For example, researchers may provide live models (e.g., Dogan et al., 2017) or video models (e.g., Treszl et al., 2021). Additionally, role-plays may be conducted with the child (e.g., Miles & Wilder, 2009) or a confederate learner (e.g., Dogan et al., 2017; Treszl et al., 2021). Such differences in the format of the training session may be the result of limited resources or time.

Coaching

Similar to BST, coaching is provided in real-time and may consist of (a) instructions, (b) prompting, and (c) performance feedback in the form of praise for steps performed correctly and

corrections for steps performed incorrectly (Bethune & Wood, 2013; Gerow et al., 2021a; Schieltz & Wacker, 2020). However, unlike BST, coaching does not involve (a) models, (b) role-play, with or without the child present, and (c) training to a pre-determined criterion level of performance. Coaching has been successfully used to train a variety of individuals to implement behaviour-analytic assessments and interventions (e.g., Benson et al., 2018; Schieltz & Wacker, 2020). However, studies often differ in their delivery of the initial instructions. For example, Bethune and Wood (2013) provided an initial training to teachers of children with ASD that outlined the components of the intervention before completing coaching sessions at a later time. On the other hand, Gerow et al. (2021a) provided instructions just prior to their coaching sessions for parents of children with ASD to train daily living skills. Further, Mouzakitis et al. (2015) found that performance feedback was needed to achieve high levels of fidelity across teachers implementing a behavioural intervention plan. However, when support was faded, fidelity levels dropped for one of three teachers. Resulting variations in treatment fidelity scores were moderately correlated with student outcome measures.

Additional research suggests parents may generalize implementation skills outside of coaching sessions (Suess et al., 2014). For example, Suess et al. (2014) found that parents maintained levels of fidelity during both coached trials and independent trials (i.e., outside of coaching trials) while implementing functional communication training procedures with their children. Overall, levels of fidelity during coached trials were related to levels of fidelity during independent trials.

Parent Training

Multiple studies have successfully trained parents–using strategies such as those described above–to implement a range of assessments and interventions including functional

analyses (Gerow et al., 2021b; Stokes & Luiselli, 2009), graduated guidance (Boutain et al., 2020), naturalistic teaching strategies (Ferguson et al., 2022), Picture Exchange Communication System (Park et al., 2011; Treszl et al., 2021), feeding protocols (Gentry & Luiselli, 2008; Mueller et al., 2003), functional communication training (Gerow et al., 2018; Nuta et al., 2021; Suess et al., 2014) and sleep interventions (Linnehan et al., 2022). Within these studies, a variety of antecedent and consequent strategies were often employed, either individually or in combination; similarly, a variety of parent training formats were employed. For example, Gerow et al. (2021b) provided BST to teach parents to implement a brief functional analysis whereas Ferguson et al. (2022) used didactic training and synchronous coaching to teach parents to implement naturalistic teaching strategies. Other training methodologies included providing verbal, written, and video performance feedback (e.g., Stokes & Luiselli, 2009); instructions, performance feedback, and self-monitoring (Gerow et al., 2018); and a combination of BST and ongoing coaching (Nuta et al., 2021). Similarly, the nature of ongoing support differs amongst studies. For example, after providing an initial BST session without the child present, Nuta et al. (2021) provided ongoing coaching support in the form of supportive and corrective feedback to parents during each parent-child session as parents learned to implement multiple antecedent and consequent strategies. Given the fact that these complex behavioural interventions are often implemented in homes and parents are the primary behaviour-change agents, parent training or coaching is important.

Parent Training, Treatment Fidelity, and Sleep Interventions

Parent trainings for sleep interventions vary. For example, Johnson et al. (2013) created a manualized behavioural parent training program for parents of children with ASD over an 8-week period. The training program consisted of instruction, models, role-play, and homework

activities. Parent treatment adherence measures were collected using parent report; parents completed homework activities that required them to self-report on how often the behavioural procedures were being used at home. Although parents self-reported that their treatment adherence was high at two time points (i.e., the fourth week and the eighth week), no direct measures were used to assess parents' treatment fidelity.

Linnehan et al. (2022) trained one set of parents to implement a behaviour-analytic sleep intervention for their child with ASD who had challenges with initiating and maintaining sleep. The training package included (a) 1 hr session in which the experimenters provided parents with the rationale and purpose of each treatment component, (b) a BST session in which parents were taught how to implement each strategy, and (c) coaching in which a consultant observed parents implementing the intervention over a 10-day period. During the coaching component, parents were required to implement treatment components with 100% accuracy across three consecutive days. Finally, during intervention, a consultant visited the family once a week to review sleep data and discuss implementation. Although parents were trained to fidelity at the start of the intervention, intervention continued for 65 days, and the experimenters did not collect ongoing treatment fidelity data, and thus could not report on whether parents continued to implement the intervention with fidelity after coaching support was removed.

Similar to Linnehan et al., Jin et al. (2013) trained parents within a 2 hr BST session and then visited the house at least twice per week to deliver feedback on intervention implementation. Parents were also provided with an intervention checklist and were asked to specify whether they implemented a particular strategy. If parents were not able to implement a strategy, then they commented on barriers to intervention implementation. Nevertheless, parents' self-reported average treatment fidelity percentages were reported.

McLay et al. (2019b) investigated the effectiveness of an FBA-informed multi-component behavioural intervention for seven children with ASD and reported collecting procedural integrity data (i.e., parent's implementation of the intervention, as designed) over 30-36% of nights. A mean procedural integrity score of 94% (range, 91-98%) was reported; however, these data were collected by comparing the parent-reported notes on sleep logs (e.g., the time the child was bid goodnight, how they responded to sleep-interfering behaviours/night wakings) and the steps of the intervention plan–meaning there was no direct observation of parent implementation. Additionally, two of the seven children withdrew from the study and McLay et al. (2019b) identified these two parents as experiencing difficulty adhering to the intervention plan–though this may not explain why these parents chose to withdraw.

Treatment fidelity is defined as the consistent application of the independent variable, the intervention, as prescribed (Falakfarsa et al., 2021). Collecting treatment fidelity data, using an objective measure, improves confidence that a functional relationship exists between the dependent and independent variables (Arkoosh et al., 2007; Falakfarsa et al., 2021; Progar et al., 2014). Further, treatment fidelity data allow researchers and clinicians to evaluate whether poor intervention outcomes may be explained by treatment fidelity errors or ineffective interventions (Progar et al., 2014). Despite the value of collecting treatment fidelity data, studies may not report treatment fidelity outcomes generally (Falakfarsa et al., 2021; McIntyre et al., 2007). Further, within sleep intervention, treatment fidelity outcomes are not typically collected or reported (McLay et al., 2020).

Research that does explore treatment fidelity suggests that varying levels of fidelity may impact intervention success (Fryling et al., 2012). For example, St. Peter Pipkin et al. (2013) examined errors of commission (i.e., reinforcement of incorrect responses) and errors of

omission (i.e., missing reinforcement of correct responses) within a differential reinforcement of alternative behaviour protocol. They found that errors of commission had greater negative impacts on treatment effectiveness than errors of omission. Additional research suggests intervention outcomes may still be maintained if interventions are initially delivered with high levels of fidelity, suggesting that high levels of fidelity during the initial stages of training may be uniquely important (Stephenson & Hanley, 2010). However, to-date, the optimal level of fidelity required to maintain intervention outcomes generally–or within sleep interventions more specifically–has not been evaluated. Further, given the nature of sleep interventions for children, parents are typically the primary mediators (McLay et al., 2020), therefore, training parents to implement sleep interventions with high levels of fidelity is important.

In a systematic review of sleep interventions delivered via telehealth (McLay et al., 2020), seven of the ten studies focused on changing parental behaviour related to the implementation of the sleep intervention to treat children's sleep challenges; however, none of these studies reported parent outcomes, such as treatment fidelity, using an objective measure. Further, parent training approaches varied (e.g., parent education in the form of written online manuals or workbooks, BST, or telephone contact). Additionally, of the studies targeting parental behaviour change, none included children with ASD.

Research supports parent-implemented, behaviour-analytic sleep interventions to address sleep problems in children with ASD (Jin et al., 2013; McLay et al., 2019b; McLay et al., 2020; Sanberg et al., 2018). Further, parents value receiving training and ongoing support (Kirkpatrick et al., 2019; Pattison et al., 2020). However, parent training approaches and the nature of ongoing implementation support vary in the sleep literature (Pattison et al., 2020) and there is no clear guidance regarding the level of support that parents require to implement sleep

interventions with fidelity. Although some studies may report on general measures such as procedural integrity or parent self-report, they often do not collect direct data (i.e., objective) on the accuracy of parent implementation of the sleep intervention (i.e., treatment fidelity). This limits the conclusions that can be made as to whether parents are implementing interventions as designed; and draws into question whether child behaviour changes can be attributed to the sleep interventions. Further, it limits our understanding of whether these interventions–as designed–are feasible for families to implement in the home environment. More research is needed to determine how accurately parents implement behavioural sleep interventions and whether parent training interventions delivered via telehealth are effective in terms of improving children's sleep.

Purpose

This research study evaluated whether parents could be trained, via telehealth, to accurately implement and monitor their child's 12-week behaviour-analytic sleep intervention. Further, parents' ability to manage the sleep intervention as nighttime coaching was systematically faded was monitored. This research extends previous research (e.g., Jin et al., 2013; Linnehan et al., 2022; McLay et al., 2019b) demonstrating the effectiveness of parent-led behavioural sleep interventions by monitoring (a) parent treatment fidelity, (b) parents' ability to make decisions related to their child's sleep intervention (i.e., decision-making accuracy), and (c) child progress in terms of sleep onset delay (i.e., how long it took children to fall asleep), total duration of sleep alone in own bed, and occurrence of sleep-interfering behaviours. It further extends the literature by exploring the use of telehealth to deliver parent training and coaching, and to monitor child outcomes.

The present study was designed to answer the following research questions:

1) What are the effects of a BST and nighttime coaching program provided via telehealth on parents' treatment fidelity, decision-making accuracy, and stress levels?
2) Is the behaviour analytic assessment and treatment model acceptable to parents? Which assessment, treatment and/or training elements do parents find most and/or least helpful?
3) Is a telehealth-based parent-training intervention effective in improving sleep for children with ASD as evidenced by children's sleep onset delay, total duration of sleep alone in own bed, and sleep-interfering behaviours?

Methods

Participants

A recruitment poster (see Appendix A) describing the study was distributed at a community-based clinic that provides ABA services and on relevant social media platforms (e.g., Twitter and Facebook). Fifteen families requested more information about the study. After receiving the parent information letter (see Appendix B), ten families met with the primary student investigator. Families who met the inclusion criteria (described below) were invited to participate (n = 5). One family opted not to participate resulting in a total of four parent-child dyads who participated in the study. Children who were taking melatonin were not excluded from the study and their parents were not required to discontinue the use of melatonin. This decision was made to be as inclusive as possible.

Each parent-child dyad included in the study met the following inclusion criteria:

a) Child chronological age between 3 and 8 years old;
b) Diagnosis of an autism spectrum disorder, confirmed by a review of diagnostic reports conducted by relevant regulated health professionals (e.g., psychologists);

c) A minimum of one sleep challenge. These were operationalized as unwanted co-sleeping or disruptive night wakings, as determined by parent interview. Unwanted co-sleeping was defined as parents or other family members sleeping near (i.e., in close proximity to) the child, either in the same bed or room, and this arrangement was undesirable to the parent. Disruptive night wakings were defined as any occurrence of challenging behaviours that hindered parent's sleep (e.g., child leaves the bedroom overnight, child calls out to parents after being put to bed, child enters the parent's bedroom to sleep after he or she is put to bed);
d) No underlying medical concerns or health issues that may be associated with the child's sleep problems, confirmed by a primary care physician;
e) Access to a reliable internet connection and computer, phone, or tablet.

Mothers were the primary parent participants for the four children involved in the study; however, three of the four participants' husbands (i.e., P1, P2, and P4) were regularly involved with the sleep intervention. Researchers queried the availability of another person in the home to support the implementation of the sleep intervention prior to each participant's baseline. Although not a requirement for participation, all primary parents indicated that support would be available, and their husbands would provide that support. For example, parents often completed the bedtime routine together or on occasion, the husband would step in to implement independently. In these situations, researchers continued data collection and graphed both parents as a family unit. All children in the study were from two-parent households. Miya previously participated in a sleep study, but results did not maintain. Additional demographic information for the primary parents is displayed in Table 1 and demographic information for the children are displayed in Table 2.

Table 1

Parent Participant Demographic Information

	P1; Zoya*	P2; Miya*	P3; Erin	P4; Mandy*
Age	41	36	44	42
Gender	Female	Female	Female	Female
Highest level of education	Bachelors	Bachelors	Bachelors	Bachelors
Employment status	Full-time	Full-time	Full-time	Part-time
Household income per year ($)	50,000 – 74,999	200,000 or more	50,000 – 74,999	100,000 – 149,999
Minority status	Yes	No	No	No
Ethnic origin	Filipino	Canadian	Canadian	Canadian
Primary language	English	English	English	English
Number of people in home	Four	Six	Three	Six
Support available in the home	Yes	Yes	Yes	Yes

Note. Full-time, defined as 30 hrs or more per week. Part-time, defined as less than 30 hrs per week. * = participant's husband was regularly involved in the implementation of the sleep intervention throughout the intervention period.

Table 2

Child Participant Demographic Information

	P1; Sonny	P2; Hanna	P3; Finnegan	P4; Carson
Age	7	7	3	7
Gender	Male	Female	Male	Male
Primary diagnosis	ASD	ASD	ASD, global developmental delay	ASD
Other diagnoses	Apraxia of speech, sensory processing disorder	None	Epilepsy, hearing impairment	None
Enrolled in school	Yes	Yes	No	Yes
Grade	2	2	N/A	2
Educational placement	Public elementary school	Private elementary school	Daycare	Public elementary school
Days per week in educational placement	3.5	5	4	5
Hours per day in educational placement	4.1	6	9.5	6
Additional services	ABA, SLP, OT	ABA	ABA, SLP, PT, OT	No
Naps taken?	No	No	Yes; 2 hr nap	No
Melatonin	Yes	No	No	Yes

Note. N/A = not applicable. Finnegan attended a daycare setting at the time of the study. ABA = applied behaviour analysis; SLP = speech-language pathology; OT = occupational therapy; PT = physical therapy.

Personnel

Each participant was assigned their own research team (i.e., sleep team). The sleep team consisted of a Board Certified Behaviour Analyst (BCBA) or a Board Certified Behaviour Analyst-Doctoral (BCBA-D) and a graduate-level research assistant (i.e., sleep coach). Each participant's intervention was designed and supervised by a BCBA or BCBA-D with extensive experience in sleep assessment and intervention. Sleep coaches were graduate students in ABA/psychology who were pursing certification as BCBAs and had between four to six years' experience studying and implementing ABA strategies. Under the supervision of a BCBA or BCBA-D, sleep coaches provided training to parents on data collection, intervention, and decision-making. Similarly, the sleep coaches supported parents during nighttime coaching, provided daily text feedback to parents about their treatment decisions, and collected data on parent and child behaviours.

Setting

All components of this study (i.e., initial screening, assessment, parent training sessions, and nighttime coaching) were conducted using secure videoconferencing and instant messaging technology (i.e., telehealth). Parents were free to choose a location in their own home (e.g., living room, kitchen) to attend the initial screening, assessment, and parent training sessions. Following this, parents implemented the intervention each night in their child's bedroom and relevant surrounding areas (e.g., hallway). During nighttime coaching and over the rest of the night, the child's bedroom was either dark (i.e., lights off) or dimly lit (e.g., nightlight or lamp turned on). Sleep coaches and BCBAs observed the bedtime routine and the child's overnight sleep and wake activity using telehealth technology from a private location in their own home.

Materials

Video Conferencing Equipment

Two platforms were used for video conferencing: (1) VSee clinic, and (2) VSee messenger. VSee provides end-to-end encryption, and completely safeguards data from unauthorized access. VSee complies with data privacy laws including the Personal Information Protection and Electronic Documents Act (PIPEDA), Freedom of Information and Protection of Privacy Act (FIPPA), and Personal Health Information Protection Act (PHIPA).

All sleep coaches and parents used their own computer, phone, or tablet to access the video conferencing platforms. BCBAs and sleep coaches were instructed to access VSee clinic and VSee messenger only from a secure network. Both platforms allowed secure group video chats, screensharing, file sharing, and stand-alone instant messaging. Group video chats and screensharing via VSee clinic were used for the initial screening, assessment, and parent training sessions. File sharing and stand-alone instant messaging via VSee messenger were used to provide text feedback during live nighttime coaching and in the morning.

D-Link Security Cameras and mydlink app

A D-Link HD Wi-Fi security camera, with night vision, sound and motion detection, remote viewing options, and event recording features, was placed in an inconspicuous location in each child's bedroom (e.g., on a shelf in the corner of the bedroom, on a dresser). The camera provided nighttime vision for up to 5 m (i.e., 16 ft).

The D-Link camera was connected to the mydlink app. This app allowed each sleep team and parent to view live video when the camera was on and access video event recordings when the camera was both on and off. Upon detection of sound or motion the mydlink app alerted the sleep team and primary parent, and a video event recording was uploaded to a secure cloud-based storage system.

iPad

Each sleep coach received their own designated iPad to access VSee and the mydlink app. The iPads were password protected and had limited access to third-party apps. iPads were used to view live video from the D-Link cameras and temporarily store screen recordings of live observations and video event recordings.

Experimental Design

A single subject, concurrent multiple baseline across (*N*=4) participants design was used to explore the impact of parent training and nighttime coaching on the primary dependent variable, parent treatment fidelity. Parent treatment fidelity was measured across baseline, intervention, and follow-up. In addition, a pre- and post-test design was used to assess the secondary dependent variable, parent decision-making accuracy. Parent decision-making accuracy was also monitored throughout intervention. Other dependent variables included child sleep onset delay (in minutes), child total duration of sleep alone in own bed during the designated time period (in hours and minutes), and occurrences of sleep-interfering behaviours in video event recordings.

The study consisted of three phases: baseline, intervention (i.e., parent training and nighttime coaching), and follow-up. During the intervention phase, nighttime coaching was systematically faded according to the nighttime coaching schedule (see Appendix C).

Measures

Functional Assessment Measures

The SATT is “an open-ended functional assessment interview designed to identify specific sleep problems and the idiosyncratic environmental variables that contribute to each child’s sleep problems in order to inform an individualized intervention that each family finds acceptable” (Jin et al., 2013, p.167). The SATT identifies, (a) history of the child’s sleep

problems, (b) specific sleep problems and the associated antecedents and consequences, (c) child's current sleep schedule and appropriate versus inappropriate sleep dependencies, and (d) topographies of sleep-interfering behaviours and possible reinforcers. Finally, parents may describe their goals for their child's sleep (e.g., child sleeps independently, child falls asleep within a specified time period, parents establish an appropriate bedtime routine for their child).

Parent Experimental Measures and Dependent Variables

Parent treatment fidelity. Parent treatment fidelity data were collected during baseline, intervention, and follow-up using a treatment fidelity checklist designed specifically for this study (see Appendix D). These data were analyzed to monitor for the effects of intervention (i.e., BST and nighttime coaching) on the parent's accurate implementation of the sleep intervention.

Parent treatment fidelity was defined as the percentage of sleep intervention components implemented correctly (i.e., independently). The sleep coach scored items on the treatment fidelity checklist as "1","0", or "not applicable" (N/A). A score of 1 indicated that the parent implemented the item on the checklist correctly, a score of 0 indicated that the parent implemented the item on the checklist incorrectly or did not implement it, and n/a indicated that the item on the checklist did not apply (e.g., if the child did not engage in sleep-interfering behaviours then that section of the checklist would not be scored). Parent treatment fidelity data were collected live during each scheduled nighttime coaching session (approximately 30 mins; described below). As well, sleep coaches reviewed the video event recordings in the morning to collect data on relevant parent behaviour(s) that may have occurred during the night (i.e., after the scheduled nighttime coaching session). Based on the live and event recording data, the sleep coach calculated parent's treatment fidelity for each night by (1) adding the score recorded for each item, (2) dividing this score by the highest score possible (i.e., number of items that were

scored), and (3) multiplying by 100. This score represented each parent's overall score (i.e., percent correct) on the treatment fidelity checklist.

Parent decision-making accuracy. Parent's accuracy of bedtime-related treatment decisions (i.e., decision-making accuracy) was assessed pre- and post-training, and monitored throughout the intervention using the parent treatment decisions checklist (see Appendix E). These data were analyzed to monitor for the effects of the intervention (i.e., BST and nighttime coaching) on parent's ability to monitor their child's sleep progress and make decisions using their child's sleep intervention plan.

Parent decision-making accuracy was defined as the percentage of correct treatment decisions based on the criteria described in the child's sleep intervention in conjunction with the data sleep coaches entered on the sleep log. Based on the parent's data and the child's sleep intervention plan, parents were required to make treatment decisions about reinforcement delivery and their child's sleep plan for the following night. On the sleep log (see Appendix F) parents recorded: (a) the time they bid goodnight to their child, (b) fall asleep time, (c) whether their child engaged in sleep-interfering behaviour, (d) morning time awake, and (e) if their child woke up on their own or they woke them. These data were collected on a nightly basis. Parents were also able to add information about whether the child was given melatonin and parental presence or co-sleeping (Jin et al., 2013). Finally, parents were required to answer four questions on the sleep log each morning:

1. What time is bedtime tonight?
2. Will your position in the room change?
3. What will your position in the room be?
4. Did your child earn his/her reward?

As Finnegan was not co-sleeping with his parent, questions two and three were omitted from his sleep log. As such, Erin only responded to questions one and four on her sleep log each morning.

Each morning, sleep coaches recorded data on child behaviour (from video event recordings) and completed their own sleep log based on the previous night, irrespective of whether there was a scheduled nighttime coaching session. Sleep coaches then made their own treatment decisions for the following night. Then, sleep coaches compared their sleep log with the parent's sleep log. A score of "1" indicated that the parent's and sleep coach's responses matched. A score of "0" indicated that the parent's and coach's responses did not match. Following this, sleep coaches calculated a percentage for parent decision-making accuracy by (1) adding the score recorded for each item, (2) dividing this score by 4 (or 2 in the case of P3), and (3) multiplying by 100. This score represented each parent's decision-making accuracy (i.e., percent correct).

Parent stress. Parent stress was assessed using the Parenting Stress Index 4th Edition Short Form (PSI-4-SF; Abidin, 2012) pre- and post-intervention. Each participant's mother was asked to complete the PSI-4-SF. This inventory provides a measure of stress within the parent-child system in three domains: (a) child characteristics, (b) parent characteristics, and (c) situational and demographic life stress. A Total Stress score and three domain-specific scores may be obtained (i.e., Parent Distress, Parent-Child Dysfunctional Interaction, Difficult Child). The child and parent domains are combined to form the Total Stress score. In general, scores between the 16th to 84th percentile are considered normal; scores between the 85th to 89th percentile are considered high; and scores in the 90th percentile or higher are considered clinically significant.

Social Validity. Social validity refers to the importance and acceptability of intervention goals, procedures, and outcomes (Kazdin, 1977). Parents were asked to rate their knowledge of, and willingness to continue, the intervention; the acceptability and feasibility of the intervention; the severity of their child's sleep problems; and any potential negative consequences that might occur as a result of the intervention. The form also included four open-ended questions for parents to comment on the components of the intervention that they found most and least helpful, recommendations for improvements, or any other information that they would like to share about their child's or family's progress.

Child Experimental Measures and Dependent Variables

Child sleep-related behaviours. In addition to monitoring parent's treatment fidelity and decision-making accuracy, child sleep-related behaviours were also monitored during baseline, intervention, and follow-up. Data were collected on the child D-Link datasheet (see Appendix G). These data were analyzed to monitor the effects of the individualized intervention on child sleep-related behaviours (i.e., fall asleep time, total sleep duration, and occurrences of sleep-interfering behaviour).

Data on child sleep-related behaviours were collected using the video event recordings from the mydlink app. To evaluate the accuracy of the data collected via video event recordings (i.e., discontinuous data) these data were compared to data collected via continuous video recordings (i.e., continuous data). This calibration was completed prior to the start of the study. Data were collected over a two-night period from both continuous video recordings and event recordings from a child not involved in the study. Results for fall asleep time, total sleep duration, and occurrences of sleep-interfering behaviours were compared. Results indicated that

the correspondence for fall asleep time was 93% (range, 86%–100%), total sleep duration was 81% (range, 77%–85%), and sleep-interfering behaviours was 100%.

Following the calibration process, data were collected for study participants from D-Link video event recordings on the following child-related sleep behaviours: asleep, awake, fall asleep time, sleep-interfering behaviours, and morning time awake. These data were then used to calculate sleep onset delay and total sleep duration alone in own bed.

Asleep. Asleep was defined as the child lying on his or her back, stomach, or side, without any signs of being awake (defined below) or covers were covering the child's entire body with minimal physical movement.

Awake. Awake was defined as any occurrence of (a) sleep-interfering behaviour (defined below), (b) eyes open (if eyes were visible), (c) lifting head from the pillow, (d) any vocalizations (e.g., humming, babbling, talking), (e) repetitive vocal stereotypy (e.g., giggling, humming, scripting), (f) repetitive motor stereotypy (e.g., head shaking, body rocking), (g) the child's hands actively manipulating or repeatedly flapping any items (e.g., books, video games, toys, papers, socks, pillowcases, or curtains), (h) excessive physical movement such as no contact between back to any part of the bed (e.g., sitting up), (i) stretching, or (j) lifting limbs. Exclusions may include movements commonly associated with sleep (e.g., rolling over, shifting body position). The *awake* definition was modified for each participant after viewing each child's baseline D-Link video event recordings.

Fall asleep time. Fall asleep time was defined as the child lying on his or her back, stomach, or side, without any signs of being awake or covers were covering the child's entire body with minimal physical movement following 15 mins of no awake behaviour or sleep-interfering behaviour. This time was recorded at the start of the 15 min period with no

movement. For example, if there was no movement for 15 mins after 9:00 pm then 9:00 pm was recorded as the fall asleep time.

Sleep onset delay. Sleep-onset delay was defined as the amount of time, in minutes, elapsed from when the parents bid the child goodnight to when the child met the definition for fall asleep time. For baseline, intervention, and follow-up, sleep onset delay was calculated nightly.

Sleep-interfering behaviours. Sleep-interfering behaviours were defined as any occurrence of (a) an obvious audible vocalization coming from the child (e.g., crying, calling out, making requests, or screaming) for greater than 5 s, (b) getting out and staying out of bed (i.e., child left the bed or was not in bed), (c) standing in bed, (d) engaging in motor stereotypy (e.g., head shaking, body rocking, hand flapping) or the child's hands actively manipulating any items such as books, video games, toys, papers, socks, pillowcases, or curtains, or engaging in vocal stereotypy (e.g., giggling, humming, scripting) for greater than 30 s, or (e) any occurrence of self-injurious behaviour. These behaviours were hypothesized to be incompatible with asleep behaviour (as defined above). Sleep-interfering behaviours were not coded after the time indicated in the morning time awake definition. The *sleep-interfering behaviours* definition was individualized for each participant after viewing baseline D-Link video event recordings (see Table 3).

Table 3

Child Participant Sleep-Interfering Behaviours

	Sleep-interfering behaviours
Sonny	(a) vocalizations that are above conversational level (e.g., crying, calling out, making requests, or screaming) for greater than 5 s, (b) getting out and staying out of bed (i.e., child left the bed or was not in bed), (c) standing in bed, (d) engaging in motor stereotypy (e.g., head shaking, body rocking, hand flapping) or the child's hands actively manipulating any items such as books, video games, toys, papers, socks, pillowcases, or curtains for greater than 30 s, or (e) engaging in vocal stereotypy (e.g., giggling, humming, scripting) for greater than 30 s.
Hanna	(a) vocalizations that are above conversational level (e.g., yelling, screaming) for greater than 5 secs, (b) getting out and staying out of bed (i.e., child left the bed or was not in bed), (c) laying down with parent on parent mattress or in their target location (d) standing in bed, or (e) manipulating items such as books, toys with the lights on. If lights are off and child is manipulating items than this will not be counted as a sleep-interfering behaviour.
Finnegan	(a) (a) vocalizations that are above conversational level (e.g., crying, calling out, making requests, or screaming) for greater than 5 s, (b) getting out and staying out of bed for more than a minute (child left the bed or was not in bed), (c) standing in bed, (d) engaging in motor stereotypy (e.g., head shaking, body rocking, hand flapping) or the child's hands actively manipulating any items such as books, video games, toys, papers, socks, pillowcases, or curtains for greater than 30 s, (e) engaging in vocal stereotypy (e.g., giggling, humming, scripting) for greater than 30 s, or (f) self-injurious behaviour such as headbanging, defined as Finnegan hitting his head into his pillow two or more consecutive times, or hitting his head at least once on any hard surface (e.g., wall, night table).
Carson	(a) getting out and staying out of bed (i.e., child left the bed or was not in bed).

Note. These definitions were created based on the results of the SATT and baseline observation.

Each family was also asked to identify the behaviours they believed interfered with their child's ability to fall and stay asleep.

For each video event recording, sleep-interfering behaviour was recorded as “yes”, “no”, or “N/A”. A score of “yes” was recorded if sleep-interfering behaviours occurred, as defined above, during the event recording. A score of “no” was recorded if sleep-interfering behaviours did not occur. Not applicable (i.e., “N/A”) was recorded if the video event recording was coded as asleep as the child cannot engage in sleep-interfering behaviour if he/she is asleep. Sleep-interfering behaviours were represented as a frequency of video event recordings with sleep-interfering behaviour. For baseline and intervention, data on the occurrences of sleep-interfering behaviours in the video event recordings were recorded three nights per week. These nights were randomly selected using a random list generator (i.e., random.org). For follow-up, data on the occurrences of sleep-interfering behaviours in the video event recordings were recorded on follow-up nights.

Morning time awake. Morning time awake was defined as the time that either (a) the parent entered the child’s room and said “good morning” at or after the time indicated in Table 4 or (b) the child opened his or her eyes, sat in their own bed (i.e., no contact between back and head to any part of the bed) and left the bed (i.e., child’s two feet touch the floor) after the selected wake-up time as indicated in Table 4. The morning time awake was recorded to the minute that either of these two events occurred. If neither of these events occurred by the time the D-Link camera was turned off, then the time of the last clip was recorded as the morning time awake. For baseline, intervention, and follow-up, these data were collected nightly. If the child left the room and did not return before the established bedtime, this was counted as sleep-interfering behaviour and the morning time awake.

The preferred awake time varied for each child; the time was selected in consultation with each child's parent and considered the family's schedule and routine preferences, as well as the child's chronological age. See Table 4 for each child's individual awake window.

Table 4

Parent's preferred awake time window for their child

	Time
Sonny	7:00 AM – 8:00 AM
Hanna	6:30 AM – 7:15 AM
Finnegan	5:00 AM – 5:30 AM
Carson	6:30 AM – 7:30 AM

Total duration of sleep alone in own bed. Total duration of sleep alone in own bed was defined as the amount of time the child was asleep, during the parent's desired sleep period for their child, each night. This was the duration of time from the child's bid goodnight time to the child's morning time awake, with the total duration of video event recordings coded as awake subtracted. Each video event recording was recorded as either awake or asleep (as defined above). If there were multiple video event recordings within a 15 min period coded as 'awake' then the full 15 min period was excluded from the total sleep duration. For example, if there were clips from 9:10:30–9:15:30 and 9:20:30–9:25:30 coded as awake then the period from 9:15:30–9:20:30 was also captured as awake and subtracted from the total sleep duration. This was done to avoid overestimating the total sleep duration. Total duration of sleep alone in own bed was recorded in hours and minutes. Only time when the child was asleep in their own bed was included in the total sleep duration. Further, if the child woke up after the designated morning time awake period (e.g., 7:00 AM–8:00 AM), this time was excluded from the total sleep duration.

For baseline and intervention, total sleep duration was calculated three nights per week. These nights were randomly selected using a random list generator (i.e., random.org). The research team was interested in assessing a practical approach to intervention that could be implemented by community professionals–as such, total sleep duration data were calculated for a random sample of nights each week. Further, total sleep duration data were not needed for the parents or sleep team to make treatment decisions on a nightly basis; criteria to move forward within each child's sleep intervention was dependent on sleep onset delay and the occurrence or non-occurrence of sleep-interfering behaviours. For follow-up, total sleep duration was only calculated on follow-up nights.

Parent Interobserver Agreement

All live observations were recorded. Observations were placed in a random number generator (i.e., random.org) and a minimum of 30% of these observations, across baseline, coaching, and fading (for Zoya), and 25% of these observations for follow-up for each participant, were scored for interobserver agreement. An independent, trained graduate-level research assistant watched randomly selected observations and independently collected data on parent treatment fidelity. The research assistant was not told the purpose of the study and was naïve to the condition of the video she was scoring. The primary student investigator trained the research assistant using verbal and written instructions, models, and feedback, until she independently achieved a criterion of 80% agreement across two nights for each participant.

For parent treatment fidelity, trial-by-trial IOA was calculated by dividing the total number of agreements over the total number of agreements plus disagreements per item and multiplying by 100. An agreement was defined as both observers recording the same score for the same item on the checklist. A disagreement was defined as both observers recording a

different score for the same item on the checklist. Parent interobserver agreement results are displayed in Table 5.

Table 5

Interobserver Agreement for Parent Treatment Fidelity Across Phases of the Study

Study Component	P1; Zoya	P2; Miya	P3; Erin	P4; Mandy
Baseline	93% (92%–93%)	81% (77%–87%)	80% (75%–83%)	90% (79%–100%)
Intervention	86% (75%–95%)	84% (76%–93%)	86% (79%–94%)	88% (75%–100%)
Fading	81% (79%–84%)	-	-	-
Follow-up	93%	76%	87%	-

Note. A cell with a dash indicates no data were collected.

Child Interobserver Agreement

Trained undergraduate and graduate research assistants watched the event recordings for randomly selected nights and independently collected data for child sleep-related behaviours, including occurrences of sleep-interfering behaviours, and calculated sleep onset delay and total sleep duration. Nights were placed in a random number generator (i.e., random.org) and 30% of these nights, across each study condition (e.g., baseline, intervention, and follow-up) for each participant, were scored for interobserver agreement. The research assistants were not told the purpose of the study and were naïve to the condition of the video they were scoring. The primary student investigator trained the research assistants using verbal and written instructions, models, and feedback, to a criterion of 80% agreement across two nights for all relevant child behaviours, for each participant.

For sleep onset delay and total sleep duration, total duration IOA was calculated by dividing the shorter duration over the longer duration and multiplying by 100. For sleep-

interfering behaviours each video event recording was considered a trial. Trial-by-trial IOA was then calculated by dividing the number of trials agreed upon by the total number of trials agreed and disagreed and multiplying by 100. An agreement was defined as both observers recording the occurrence or non-occurrence of sleep-interfering behaviour for the same video event recording. A disagreement was defined as both observers recording different responses for the occurrence or non-occurrence of sleep-interfering behaviour for the same video event recording. Child interobserver agreement results for total sleep duration are displayed in Table 6, sleep onset delay in Table 7, and sleep-interfering behaviours in Table 8.

Table 6

Interobserver Agreement for Total Sleep Duration Across Phases of the Study

Study Component	P1; Sonny	P2; Hanna	P3; Finnegan	P4; Carson
Baseline	100%	90% (86%–95%)	100%	95% (90%–100%)
Intervention	97% (92%–100%)	94% (83%–100%)	94% (85%–100%)	89% (56%–100%)
Follow-up	99% (97%–100%)	97% (95%–98%)	86% (79%–93%)	-

Note. A cell with a dash indicates no data were collected.

Table 7

Interobserver Agreement for Sleep Onset Delay Across Phases of the Study

Study Component	P1; Sonny	P2; Hanna	P3; Finnegan	P4; Carson
Baseline	94%	100% (99%–100%)	97% (97%–98%)	86% (64%–100%)
Intervention	95% (61%–100%)	93% (51%–100%)	94% (64%–100%)	94% (63%–100%)
Follow-up	90% (82%–97%)	66% (31%–100%)	100%	-

Note. A cell with a dash indicates no data were collected.

Table 8

Interobserver Agreement for Sleep-Interfering Behaviours Across Phases of the Study

Study Component	P1; Sonny	P2; Hanna	P3; Finnegan	P4; Carson
Baseline	85%	89% (87%–90%)	84% (78%–92%)	90% (80%–100%)
Intervention	90% (67%–100%)	81% (67%–100%)	86% (74%–94%)	84% (65%–91%)
Follow-up	96% (92%–100%)	78% (74%–81%)	86% (84%–88%)	-

Note. A cell with a dash indicates no data were collected.

Procedures

Intake, Consent, Demographic, and PSI

Interested participants met with the primary investigator and BCBA-D in an initial screening to determine whether they met inclusion criteria. Families who met inclusion criteria were invited to participate in the study. Invited parents uploaded a diagnostic report confirming their child's diagnosis to a secure Sync folder. Parents were also asked to confirm that they met with either a family doctor or pediatrician to rule out any underlying medical reasons for their child's sleep challenges. At the same time, written, informed consent (see Appendix H) was obtained from the parents for both parent and child participation. Parents also completed the demographic information form (see Appendix I) and received a blank copy of the PSI-4-SF to complete and return via mail before baseline.

Equipment Set-Up Training

The primary student investigator or BCBA trained each parent to set up the D-Link camera in their home. During this training, each parent placed the camera in their child's bedroom and the primary student investigator confirmed that she could see the child's bed and

relevant surrounding areas (e.g., room entrance, area around bed), that sound and motion were appropriately being detected, and video event recordings were uploading to the mydlink app.

Indirect Functional Behaviour Assessment of Child

The sleep coach and BCBA met with each parent to complete the first seven sections of the SATT; The SATT was administered in interview format. See Table 9 for a summary of SATT results.

Table 9

Sleep Assessment and Treatment Tool Results for Child Participants

	Hypothesized Function for Sleep-Interfering Behaviours	Parent-Identified Sleep Goals	Sleep-Interfering Behaviour	Delayed Sleep Onset Reported
Sonny	Socially-mediated positive reinforcement in the form of parent attention	• Establish bedtime routine • Fall asleep independently without parental or sibling presence • Stay asleep in own bed, independently	• Nighttime routine noncompliance • Calls out to parents • Leaves bed • Night awakenings	Yes
Hanna	Socially-mediated positive reinforcement in the form of parent attention	• Fall asleep independently without parental presence • Stay asleep in own bed, independently	• Nighttime routine noncompliance • Calls out to parents • Crying • Leaves bed • Night awakenings	Yes
Finnegan	Non-socially mediated positive or negative reinforcement	• Perform bedtime routine upstairs • Stay asleep in own bed, independently	• Nighttime routine noncompliance • Crying • Night awakenings	Yes
Carson	Socially-mediated positive reinforcement in the form of parent attention	• Fall asleep independently without parental presence • Stay asleep in own bed, independently	• Calls out to parents • Leaves bed • Night awakenings • Early awakenings	Unsure

Note. Delayed sleep onset reported; parents were asked if their child typically took longer than 15 mins to fall asleep.

Baseline of Parent Treatment Fidelity

Prior to baseline, the primary student investigator asked each parent to describe their child's desired sleep routine and bedtime. This information was used to determine whether parents followed their desired sleep routine, as indicated, during baseline observations.

Parents' treatment fidelity data were collected during 30 min live observations of each child's sleep routine. The sleep coach conducted live observations online, using the mydlink app remote viewing feature. The coach logged into VSee to use the stand-alone instant messaging feature to notify parents that he or she had begun their observation. Observations began approximately 10 to 15 mins before parents typically bid goodnight to their child. For example, if the parent indicated that their bid goodnight time was 8:45 pm, then the observation began by 8:35 PM at the latest. Similarly, observations ended 15 mins after the parent had bid their child goodnight. For example, if the parent bid goodnight to their child at 9:00 PM, then the observation ended at 9:15 PM.

During baseline, parents were asked to complete their child's regular sleep routine and respond to sleep-interfering behaviours as they typically would. No supportive or corrective feedback was provided to parents at this time.

Baseline of Parent Decision-Making Accuracy

Pre-test probes of parents' accuracy of treatment decisions were conducted prior to intervention training. Three trials were completed in which parents were given a sleep log with their child's data completed. They were asked to use the information in the sleep log and complete the treatment decisions section (described below) for the following night. No supportive or corrective feedback was provided.

Baseline of Child Sleep Behaviours

During baseline data collection of parent treatment fidelity, baseline data collection of child sleep-related behaviours also occurred. Sleep coaches collected data each morning from the D-Link event recordings. Data were collected on the bid goodnight time, fall asleep time, the morning time awake, and the occurrence of sleep-interfering behaviour. These data were then used to calculate baseline levels of sleep onset delay and total duration of sleep alone in own bed. Notably, parent training began once stability of parent treatment fidelity data was identified, regardless of whether child data were stable. However, child baseline data were used to inform the development of each child's individual sleep intervention.

Individualized Child Sleep Intervention

The results obtained from each child's baseline and SATT interview were used to design an individualized sleep intervention (see Appendix J for example). Sleep interventions included function-based, behavioural strategies (e.g., faded bedtime, disrupting contingencies between sleep-interfering behaviours and reinforcers, eliminating inappropriate sleep dependencies, reinforcement for independent sleeping and the absence of sleep-interfering behaviour). Each child's intervention included a variety of antecedent strategies that were selected to reduce child distress, increase child success at falling asleep in the context of relevant discriminative stimuli, and to support parent treatment fidelity. Interventions also included consequent strategies designed to increase sleep compatible behaviours (i.e., reinforcement) and reduce the occurrence of behaviours that interfere with sleep (i.e., extinction). Parents were given the opportunity to provide input on the intervention. Attempts were made to incorporate parent preferences and identify barriers to parent implementation and possible strategies to address these barriers. Parents provided informed, written consent to their child's individualized sleep intervention prior to implementation. Specific components of each child's individualized sleep intervention plan

are displayed in Table 10 and the specific mastery criteria for each child to move forward in their plan are displayed in Table 11. Intervention was monitored regularly, and revisions were made based on child data.

Table 10

Child Participant Sleep Intervention Plan Components

	Antecedent Strategies	Consequent Strategies
Sonny	Sleep hygiene Faded bedtime Systematic fading of parental presence Bedtime pass*	Extinction Reinforcement
Hanna	Faded bedtime Systematic fading of parental presence	Extinction Reinforcement
Finnegan	Sleep hygiene Faded bedtime	Planned ignoring Reinforcement
Carson	Faded bedtime Systematic fading of parental presence Progressive waiting**	Extinction Reinforcement

Note. *=bedtime pass was included as an antecedent strategy after Sonny met revision criteria and parents reported him to be leaving his bedroom briefly and returning to bed. ** = progressive waiting was included as an antecedent strategy after Carson met revision criteria and video event recordings showed him repeatedly leaving–and being returned by his parents–to his bedroom following the bid goodnight.

Table 11

Child Participant Sleep Intervention Plan Mastery Criteria

	Mastery Criteria
Sonny	Bedtime fading and systematic fading of parental presence dependent on falling asleep within 25 minutes of BGN and non-occurrence of sleep-interfering behaviours across two nights Reinforcement dependent on non-occurrence of sleep-interfering behaviour
Hanna	Bedtime fading dependent on falling asleep within 20 minutes of BGN over one night Systematic fading of parental presence dependent on non-occurrence of sleep-interfering behaviours over one night Reinforcement dependent on non-occurrence of sleep-interfering behaviour
Finnegan	Bedtime fading dependent on falling asleep within 25 minutes of BGN and non-occurrence of sleep-interfering behaviours across two nights Reinforcement dependent on non-occurrence of sleep-interfering behaviour
Carson	Bedtime fading dependent on falling asleep within 20 minutes of BGN over one night Systematic fading of parental presence dependent on non-occurrence of sleep-interfering behaviours over one night Reinforcement dependent on non-occurrence of sleep-interfering behaviour Progressive waiting schedule progressed every two nights, independent of the occurrence of sleep-interfering behaviours

Note. BGN = bid goodnight.

Parent Training

Parents participated in three training sessions: (1) data collection training, (2) individualized sleep intervention training, and (3) treatment decisions training. All three trainings were conducted online, without the child present, using VSee clinic. The intervention and treatment decisions trainings were conducted using BST. This included written instructions in the form of datasheets and treatment checklists, video models, role-play, and supportive and corrective feedback from the sleep team.

Data Collection Training. There were two components to the data collection training: (1) training without the child present (during the day), and (2) coaching with the child present (the same night). During the first training, parents were trained on their child's operational definitions and how to complete the sleep log (see Appendix K). These objectives were explicitly taught to ensure that each parent could accurately identify their child's sleep-related behaviours for data collection purposes. Parents were also trained to identify examples and non-examples of awake versus asleep for their child. Parents were shown the operational definitions for awake, asleep, and sleep-interfering behaviours and shown two examples of each behaviour using video event recordings from their child's baseline. Following this, parents were shown two videos for each behaviour, and they were asked to identify whether their child was awake, asleep, or engaging in sleep-interfering behaviours. Parents had the opportunity to ask questions about these definitions and their child's behaviour. Next, each component of the sleep log was explained. The primary student investigator showed parents various video event recordings of the bedtime routine, the bid goodnight routine, their child falling asleep, events in the middle of the night, and then the morning time awake. The primary student investigator then asked parents to identify the bid goodnight time, fall asleep time, whether their child engaged in sleep-interfering behaviours (based on the video event recordings from the middle of the night), and the morning time awake on the sleep log. Following this, the primary student investigator provided parents with supportive and/or corrective feedback (e.g., "yes, the fall asleep time was 9:35 pm because he closed his eyes at 9:20 pm and showed no signs of being awake" or "the fall asleep time wasn't quite right. You wrote 9:30 pm but the actual fall asleep time was 9:35 pm because he opened and closed his eyes at 9:20 pm, as seen in this clip.").

During the second data collection training (i.e., coaching) parents practiced completing the sleep log live during their child's bedtime routine and overnight. The purpose of this training was to provide parents with the opportunity to practice completing the sleep log live, with coaching and text feedback. Both the sleep coach and parent observed the child live, until the child met the definition for fall asleep, regardless of how long it took the child to fall asleep. During the live coaching, the sleep coach communicated with parents about whether they should begin their timer to identify the child's fall asleep time. The sleep coach provided feedback as to whether the child was awake or asleep (e.g., "yes, it looks like his eyes are shut. You should start the timer now. If he opens his eyes again, what should you do?"). No other training (e.g., behavioural sleep intervention training) was provided at this time and parents were asked to respond to their child's nighttime behaviours as they typically would. The following morning, after sleep coaches reviewed the video event recordings, they provided parents with text feedback on the accuracy of the remaining components of their sleep log such as the occurrence of sleep-interfering behaviours and morning time awake.

Intervention Training. Following the data collection training, each parent received training on how to implement their child's individualized behavioural sleep intervention. Parents were trained to accurately implement the sleep intervention using BST.

Parents were provided with (a) a copy of their child's behavioural sleep intervention plan (see Appendix J for example), (b) a parent handout explaining the rationale for each behavioural strategy in their child's plan (see Appendix L for example), and (c) the treatment fidelity checklist (see Appendix D). Using these handouts and checklists, each component of the behavioural intervention was explained. After this, the sleep coach reviewed each section of the treatment fidelity checklist (e.g., set up, bid goodnight routine, response to sleep-interfering

behaviour, and morning routine). Parents then watched a video showing how each section of the checklist is implemented with a confederate child. After the video, the sleep coach asked parents to show and/or tell how they would respond to specific scenarios (approximately 3-5 practice trials) that focused on that specific section of the checklist (e.g., set up, bid goodnight routine, response to sleep-interfering behaviours, or morning routine). Parents were encouraged to demonstrate the target skills as much as possible; however, in the absence of the child there were times when parents described how they would perform the skill (e.g., how to respond to their child leaving the bed). The sleep coach provided frequent supportive feedback for steps performed correctly by nodding, saying "well done" or something similar, and describing the correct behaviour (e.g., "your bid goodnight routine looked great! Your timing was spot on! You also did a nice job of not saying anything else after the "goodnight".). The sleep coach also provided corrective feedback for steps that were not performed correctly or were omitted by modelling and describing the correct behaviour using non-technical terms (e.g., "If he leaves his bed, you should bring him back to bed without saying anything as we want to minimize attention for leaving the bed and we want the initial "goodnight" to signal bedtime). Parents were encouraged to redo steps in which they made errors and ask questions throughout the training.

After parents completed three to five practice trials performing each component of their child's sleep intervention, the sleep coach administered test trials with the parent(s). Parents were required to achieve $\geq$80% on the treatment fidelity checklist across three test trials before they could implement the intervention with their child at night. All parents achieved above 80% on the treatment fidelity checklist across three test trials during their first training session.

Treatment Decision-Making Accuracy Training. Following the intervention training, parents were trained to make treatment decisions about their child's sleep intervention. First, the

treatment decisions section of the nightly sleep log (see Appendix F) was provided to parents and the sleep coach described each treatment decision to the parent and provided parents with the opportunity to ask questions. Following this, the sleep coach directed parents to their child's behavioural sleep intervention plan and modelled how she used the mastery criteria to make treatment decisions for three nights. Following the model, parents completed practice scenarios. The sleep coach provided parents with sample sleep logs and a copy of their child's behavioural sleep intervention plan. The sleep coach then asked the parent to make treatment decisions about what to do the next night. Following the completion of each practice scenario, the sleep coach provided the parent with both supportive and corrective feedback—as described above. Once parents achieved ≥80% correct on the treatment decisions checklist across three training scenarios, they moved onto post-test probes. All parents met mastery criteria within the one training session.

Similar to the pre-test probes (described in baseline), the post-test probes involved three test trials where parents were given a sleep log with their child's data completed. They were asked to use the information in the sleep log and complete the treatment decisions section for the following night. No supportive or corrective feedback was provided. No written instructions were provided to parents.

Nighttime Coaching

Following the intervention and treatment decisions training, the sleep coach observed the parent implementing the sleep intervention with their child at night. The sleep coach completed the parent treatment fidelity checklist during this time and provided positive and corrective text feedback in the moment, using the VSee instant messaging feature.

Each morning, parents were asked to complete the treatment decisions section of the nightly sleep log, making decisions for the next night based on their child's data. Parents also uploaded their completed sleep logs to VSee for review by the sleep coach. Each morning, sleep coaches collected data on child sleep measures using video event recordings, as described above. Using these data, sleep coaches made treatment decisions about the child's sleep intervention for the next night. Sleep coaches then compared their treatment decisions with the parent's completed sleep log and scored the parent's accuracy in decision making using the parent's treatment decisions checklist. If parents made one or more correct decisions about their child's sleep intervention, the sleep coach provided positive feedback to parents and notified them to continue based on their treatment decisions. For example, if the sleep coach identified that the child met the mastery criterion for the current step—necessitating a change in bedtime—and the parent also identified the change in bedtime, then positive feedback was provided to parents. However, if parents made one or more incorrect decisions about their child's sleep intervention, the sleep coach provided corrective feedback to parents. For example, if the sleep coach identified that the child met mastery criterion for the current step and therefore a bedtime change was required, but the parents did not identify the mastered step and the requirement to change bedtime, then the sleep coach corrected this decision and instructed the parents to implement the new bedtime. For decision-making accuracy, there was no mastery criterion. Parents were always provided with positive and corrective feedback about their treatment decisions each morning. This decision was made to reduce the likelihood that parents would incorrectly move their children forward within their programs or delay their progression to the next step. Further, previous studies had not evaluated parents' ability to make treatment decisions–or how to fade

decision-making support–so increased support was provided in an effort to enhance decision-making accuracy.

In order to systematically reduce the frequency of nighttime coaching within the 12-week intervention period, a response-dependent fading schedule was created (see Appendix C). As parents demonstrated accurate implementation of their child's sleep intervention, (i.e., met mastery criteria according to the systematic fading schedule), the frequency of nighttime coaching was reduced. If parents met the revision criterion as indicated in the nighttime coaching schedule, then booster sessions were provided. Irrespective of the nighttime coaching schedule, parents were instructed to implement the intervention with their child, and complete the nightly sleep log, each night.

Fading Support and Booster Sessions. Nighttime coaching was systematically faded by week 12. Parents whose child mastered the sleep intervention within the 12-week period (i.e., Miya and Erin) were provided a final booster training before follow-up probes were completed. Zoya's child did not master the sleep intervention within the 12-week period and so she was provided a booster training and a fading phase where decision-making support was faded. Mandy withdrew from the intervention at week 12.

The booster training was structured the same as the intervention training (described above) but was updated to reflect the child's current sleep intervention plan. In addition to the criterion for the post-test probes (≥80%), parents were required to achieve 100% on prespecified sections of the checklist (e.g., response to sleep-interfering behaviours, morning time awake). Further, Zoya was required to achieve 100% accuracy across three test trials for treatment decisions.

The fading phase was scheduled over a 4-week period; the sleep coach provided feedback about treatment decisions every third day for the first two weeks and then every seventh day for the last two weeks. Zoya received nighttime coaching once a week and was required to achieve a mastery criterion of ≥ 80% on the checklist across two nighttime coaching sessions. Booster sessions were provided if the parent scored ≤60% on any one nighttime coaching session.

Follow-Up

Parents participated in four follow-up probes: 2 weeks, 1 month, 3 months, and 6 months post-intervention. Follow-up probes followed the same structure as the nighttime coaching sessions in which the sleep coach asked parents to complete the sleep routine as per their child's sleep intervention plan. Sleep coaches provided positive and corrective feedback to parents based on the treatment fidelity checklist. Data on parent treatment fidelity and child sleep behaviours were collected during these follow-up probes. Sleep coaches were also prepared to provide booster training sessions if treatment fidelity fell below 60% on any given follow-up night; however, no parents required these.

Parenting Stress

The PSI-4-SF was administered pre- and post-intervention. Parents were asked to return a completed copy of the PSI-4-SF to the sleep team via mail. One parent, Miya, did not return the initial PSI-4-SF and a second parent, Mandy, did not return the final PSI-4-SF.

Social Validity

To assess the acceptability of the intervention parents were asked to complete a modified version of the Treatment Acceptability Rating Form-Revised (TARF-r; see Appendix M), adapted from Reimers and Wacker, 1988. Three of four primary parents completed this form post-intervention.

Procedural Integrity

Procedural integrity data were collected during each parent training session (i.e., data collection training, intervention training, and treatment decisions training). A procedural integrity checklist created specifically for each condition was used to assess sleep coach behaviour (see Appendix N for data collection training; see Appendix O for intervention training; see Appendix P for treatment decisions training; see Appendix Q for nighttime coaching). Procedural integrity data were collected for 50% of the data collection and intervention trainings and 75% of the treatment decisions trainings. A BCBA was present for parent trainings and collected procedural integrity data on the sleep coach's behaviour live during the training. A score of "1" was recorded if the sleep coach delivered the training component correctly. A score of "0" was recorded if the sleep coach delivered the training component incorrectly or missed the step. Following this, the BCBA or BCBA-D calculated a percentage of training or coaching components completed correctly by (1) adding the number of 1s, (2) dividing this score by the total number of training or coaching components with a score of 0 or 1, and (3) multiplying by 100. This score represented the sleep coach's procedural integrity for the training. Procedural integrity was 96% (range, 92%–100%) for the data collection training, 99% (range, 98%–100%) for the intervention training, and 99% (range, 96%–100%) for the treatment decisions training.

Procedural integrity data were also collected during nighttime coaching sessions throughout intervention and follow-up phases. Randomly selected nighttime coaching sessions were assigned to the BCBA or BCBA-D to observe and use the checklist to score the sleep coach's behaviour. Procedural integrity data were collected for a minimum of 33% of nighttime coaching sessions during intervention and follow-up for each participant. The BCBA or BCBA-

D followed the same scoring procedures described above to collect procedural integrity data during nighttime coaching sessions and follow-up probes. Procedural integrity scores were averaged across intervention, and follow-up for each participant (see Table 12).

Table 12

Procedural Integrity Results Across Phases of the Study

Study Component	P1; Zoya	P2; Miya	P3; Erin	P4; Mandy
Intervention	99% (80%–100%)	100%	93% (75%–100%)	95% (67%–100%)
Follow-up	100%	100%	90% (80%–100%)	-

Note. A cell with a dash indicates no data were collected. P4; Mandy withdrew from the study before follow-up probes could be completed. For some results, no ranges are presented because all scores remained the same.

Results

Parent Treatment Fidelity

Parent treatment fidelity results are summarized in Table 13 and depicted in Figure 1. During baseline, there was a decreasing trend observed for both Zoya and Mandy, and a stable trend observed for both Miya and Erin. During coaching, there is an increasing trend observed for all participants. Overall, there was an immediate increase in level for treatment fidelity following the completion of BST and the onset of nighttime coaching for all participants. Zoya met the revision criterion once during this phase and completed two booster sessions. She did not require further boosters during this phase. No other parent required booster sessions. Further, parents maintained high levels of fidelity (i.e., above 80%) as the coaching schedule was systematically faded. During fading, Zoya maintained high levels of fidelity with the exception of meeting revision criterion once. She required three booster sessions before meeting mastery

criterion. Overall, fidelity levels from coaching were generally maintained during follow up probes for Zoya, Miya, and Erin. Finally, there was no overlap in data points between baseline, coaching, and follow up for all participants. Additionally, there was no overlap in data points between baseline and fading for Zoya. Following the 12-week intervention period, Mandy withdrew from the study; the family went on vacation and as such, they were unable to implement the intervention on a nightly basis and unavailable for scheduled weekly nighttime coaching.

Table 13

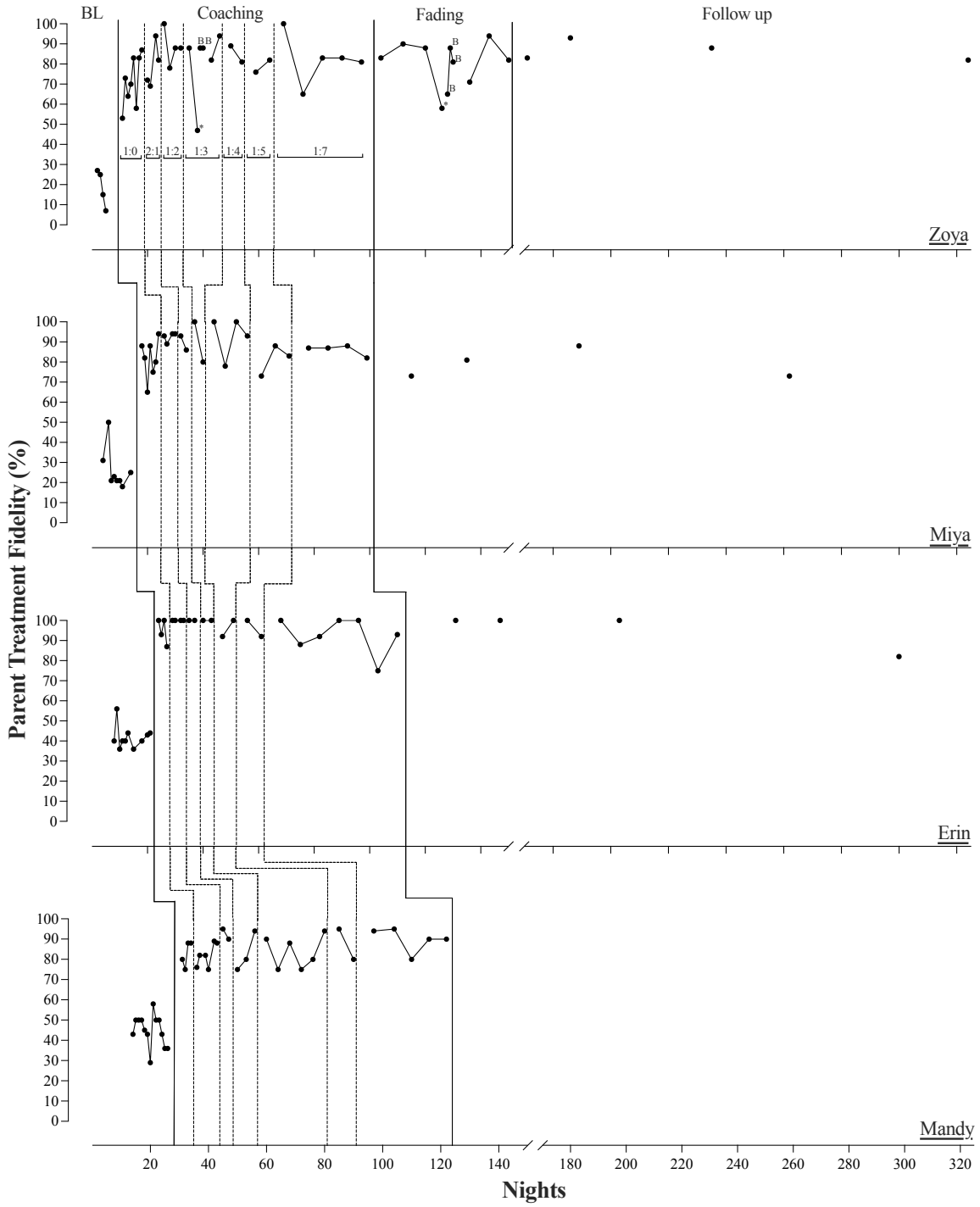
Summary of Results for Parent Treatment Fidelity Results

	P1; Zoya	P2; Miya	P3; Erin	P4; Mandy
Baseline	19% (7%–27%)	26% (18%–50%)	42% (36%–56%)	45% (29%–58%)
Coaching	80% (53%–100%)	87% (65%–100%)	96% (75%–100%)	85% (75%–95%)
Fading	80% (65%–94%)	81% (73%–88%)	96% (82%–100%)	87% (0%–100%)
Follow up	88% (82%–93%)	-	-	-

Note. A cell with a dash indicates no data were collected.

Figure 1

Parent Treatment Fidelity Results



Note. * = parents met revision criterion; B = booster sessions; 1:0 = 1 night coaching, 0 nights off; 2:1= 2 nights coaching, 1 night off; 1:2 = 1 night coaching, 2 nights off; 1:3 = 1 night coaching, 3 nights off; 1:4 = 1 night coaching, 4 nights off; 1:5 = 1 night coaching, 5 nights off; 1:7 = 1 night coaching, 7 nights off; fading = fading of nighttime coaching. Follow up probes occurred at 2 weeks, 1 month, 3 months, and 6 months post-fading for Zoya and post-coaching for Miya and Erin.

Parent Decision-Making Accuracy

Parents' decision-making accuracy results are depicted in Table 14. During the pre-test and post-test, parents completed three sleep logs each. During intervention, Zoya submitted 77 sleep logs, Miya submitted 65 sleep logs, Erin submitted 79 sleep logs, and Mandy submitted 92 sleep logs. During fading, Zoya submitted 47 sleep logs.

Overall, parents' scores increased from pre-test to post-test. Across parents, they averaged 49% (range, 29%–75%) on the pre-test and 92% (range, 75%–100%) on the post-test. These results generally maintained during the intervention, with parents averaging 89% (range, 0%–100%). During the fading period for Zoya, her average score increased from intervention, averaging 93% (range, 50%–100%).

Table 14

Summary of Results for Parents' Decision-Making Accuracy

	P1; Zoya	P2; Miya	P3; Erin	P4; Mandy
Pre-test	29% (0%–50%)	75% (25%–100%)	50%	42% (25%–50%)
Post-test	75%	92% (75%–100%)	100%	100%
Intervention	88% (25%–100%)	80% (0%–100%)	99% (50%–100%)	87% (0%–100%)
Fading	93% (50%–100%)	-	-	-

Note. A cell with a dash indicates no data were collected. For some scores, no ranges are presented because all scores were the same (e.g., Erin scored 50% on each sleep log of the pre-test).

Parent Stress

Parent stress scores are depicted in Table 15. Only two participants returned PSI questionnaires at both timepoints (pre- and post-intervention). Therefore, results are only presented for two parents. Overall, Total Stress scores (i.e., percentiles, *T*-scores) are within the normal range for both parents for both the pre- and post-questionnaires. More specifically, Total Stress scores were similar from pre to post for both Zoya and Erin. This suggests that the sleep intervention did not increase or decrease parental stress levels.

Table 15

Parenting Stress Index Results Summary Table

	P1; Zoya (Percentile, *T*-score)		P3; Erin (Percentile, *T*-score)	
	Pre	Post	Pre	Post
Total Stress	69, 54	73, 56	57, 49	44, 46
Parental Distress (PD)	96, 67	98, 70	8, 37	5, 35
Parent-Child Dysfunctional Interaction (P-CDI)	37, 44	28, 42	72, 55	70, 54
Difficult Child (DC)	52, 48	62, 51	76, 57	66, 53

Note. For Zoya, both pre- and post-intervention, percentile scores for Parent-Child Dysfunctional Interaction and Difficult Child were within the normal range. Percentile scores for Parental Distress are within a clinically significant range at both time points. For Erin, both pre- and post-intervention, percentile scores for Parent Distress, Parent-Child Dysfunctional Interaction and Difficult Child were within the normal range.

Parent Social Validity

The primary parents completed a modified version of the TARF-R (Reimers & Wacker, 1988) prior to their first follow up probe. Questions were grouped into nine categories: (1) severity of child's sleep problems, (2) negative consequence, (3) effectiveness, (4) knowledge, (5) willingness to continue, (6) feasibility, and (7) acceptability. Social validity results, represented as an average score across parents, are presented in Table 16.

Table 16

Summary of Social Validity Results

Question	Score (*M*, range)
Severity of child's problems*	
Compared to other children with sleep difficulties, how serious are your child's problems?	4.7** (4–5)
How severe are your child's sleep difficulties?	5.25 (4–5)
To what degree are your child's sleep difficulties of concern to you?	5.75 (5–6)
Negative consequences	
To what extend are undesirable side-effects likely to result from this treatment?	2.25 (1–4)
Effectiveness	
How likely is this treatment to make permanent improvements in your child's behaviour?	5.75 (5–6)
How confident are you that the treatment will be effective?	5 (3–6)
How effective is this treatment likely to be for your child?	5 (3–6)
Knowledge	
How clear is your understanding of this treatment?	5.75 (5–6)
Willingness to continue	
How willing are you to carry out this treatment?	5.5 (5–6)
How willing will other family members be to help carry out this treatment?	5 (4–6)
How willing would you be to change your family routine to carry out this treatment?	5.5 (5–6)
How well will carrying out this treatment fit into the family routine?	4.75 (4–6)
Feasibility***	
To what extent do you think there might be disadvantages in following this treatment?	2.5 (1–5)
How much time will be needed each day for you to carry out this treatment?	3.75 (2–5)
How disruptive will it be to the family (in general) to carry out this treatment?	2.75 (1–5)
Acceptability	
How acceptable do you find the treatment to be regarding your concerns about your child?	5.7** (5–6)
How much do you like the procedures used in the proposed treatment?	5.25 (5–6)
Given your child's sleep difficulties, how reasonable do you find the treatment to be?	5.5 (5–6)

Note. All items were scored on a Likert scale from 1 (*least desirable outcome or rating)* to 6 (*most desirable outcome or rating*). *= items found in *severity* are ranked from 1 (*not very severe*) to 6 (*very severe*), **= scores were averaged across three parents, ***= items found in *feasibility* were reverse-scored from 1 (*most desirable outcome or rating*) to 6 (*least desirable outcome or rating*).

Parents were also asked open-ended questions related to the most and/or least helpful components of the intervention. Responses are summarized in Table 17.

Table 17

Summary of Parent's Responses

	Most helpful	Least helpful
P1; Zoya	Nighttime coaching	mydlink app Internet issues
P2; Miya	Nighttime coaching	Limited flexibility with child's sleep intervention
P3; Erin	mydlink app	N/A
P4; Mandy	Nighttime coaching	N/A

Note. Limited flexibility with child's sleep intervention; parents implemented the intervention over 12-weeks and parents adhered to the bedtimes indicated in the sleep intervention plan. N/A = not applicable; parent did not provide a response.

Parents were also asked for any suggestions for improvements. Two of four parents responded. Zoya suggested adjusting the trainings such that parents complete an asynchronous online training before meeting with the sleep team to practice. Miya suggested allowing for more flexibility with the sleep and coaching schedules. For example, allowing her child to sleep later than the typical scheduled bedtime on nights where a parent may be working later.

Finally, parents were asked to share any other information about their child's and/or family's progress. Zoya commented on the benefits of participating in the study, stating:

> We never would have imagined we would get to where we are now. Participating in the study has given us our evenings back. Sleeping at a decent hour and doing adult chores and getting downtime without kids, is precious. We hope to continue on and improve on our routine and scale back on activities that we can fade out with more time and practise.

Miya commented on the longevity of her child's sleep intervention, stating:

> We are so grateful for everything and for all the time and energy you have invested into helping us get some sleep. I would say that it has been very effective in a lot of ways, as we now consistently can have full night sleeps. I am nervous about how it will go over time when typical life happens or we have to make changes to the routine (i.e., family trip), but I think this time around has given me more confidence to be consistent with routine and practices! Thank you so much for helping us as a family, as we felt like sleepless nights were becoming completely unmanageable before - now we have hope!

Erin commented on the collateral benefits of the sleep intervention, stating, "F's day has less behaviour issues, improvements in development, a little bit more willing to try things."

Finally, Mandy discussed her child's progress following their withdrawal from the study, stating, "C now goes to sleep almost right away. He sleeps through the night most nights AND stays in his bed. We are finally getting some sleep in this house!".

Child Dependent Variables

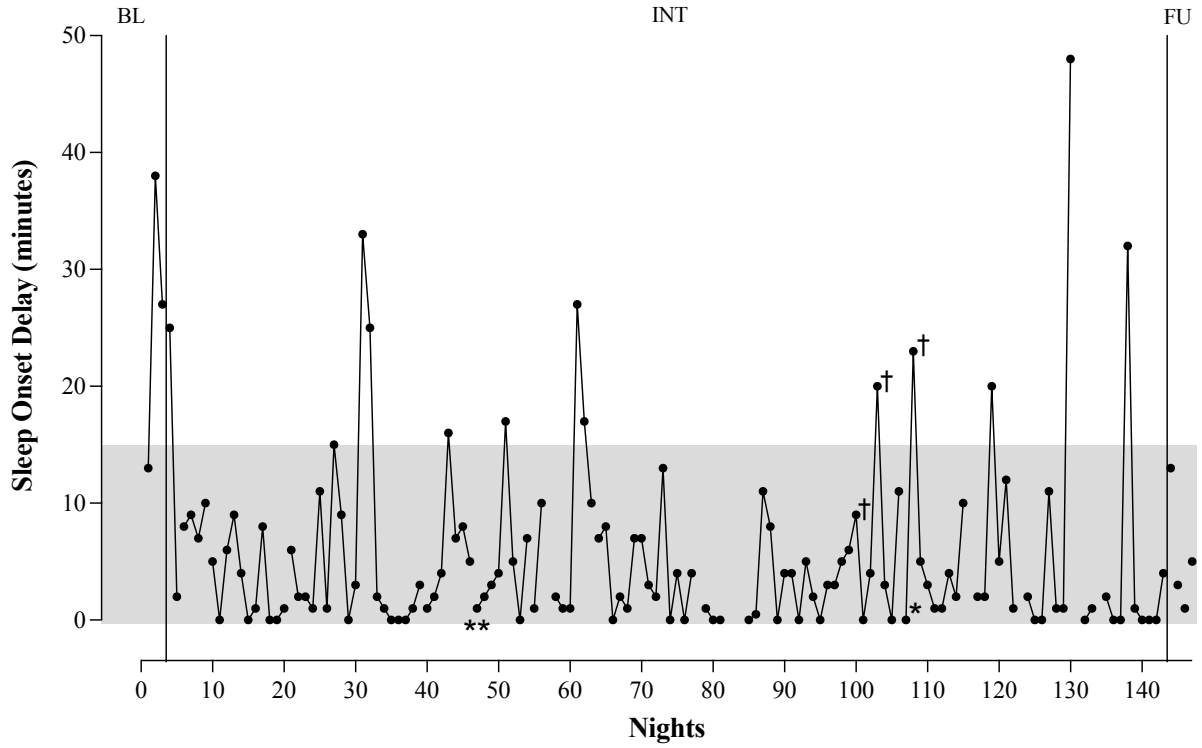
Sonny

Sleep Onset Delay. Sonny's sleep onset delay is depicted in Figure 2. During baseline, it took Sonny 26 mins, on average to fall asleep (range, 13 mins–38 mins). During intervention, it took Sonny 5.5 mins, on average to fall asleep (range, 0 mins–48 mins). During follow-up probes, it took Sonny 5.5 mins, on average to fall asleep (range, 1 min–13 mins).

Further, Sonny was falling asleep within the ideal range for sleep onset for 33% of nights during baseline (*n*=3), 91% of nights during intervention (*n*=135), and 100% of nights during follow up (*n*=4). Overall, the results show a decreasing trend from baseline to intervention. These results maintained at follow up probes.

Figure 2

Sleep Onset Delay (Sonny)



Note. Grey shaded area = ideal sleep onset range (i.e., within 15 min). BL = baseline; INT = intervention; FU = follow-up probes; * = parent sleeping in their own bedroom; ** = target bedtime achieved; † = no melatonin administered. Follow up probes were conducted at 2 weeks, 1 month, 3 months, and 6 months post-intervention.

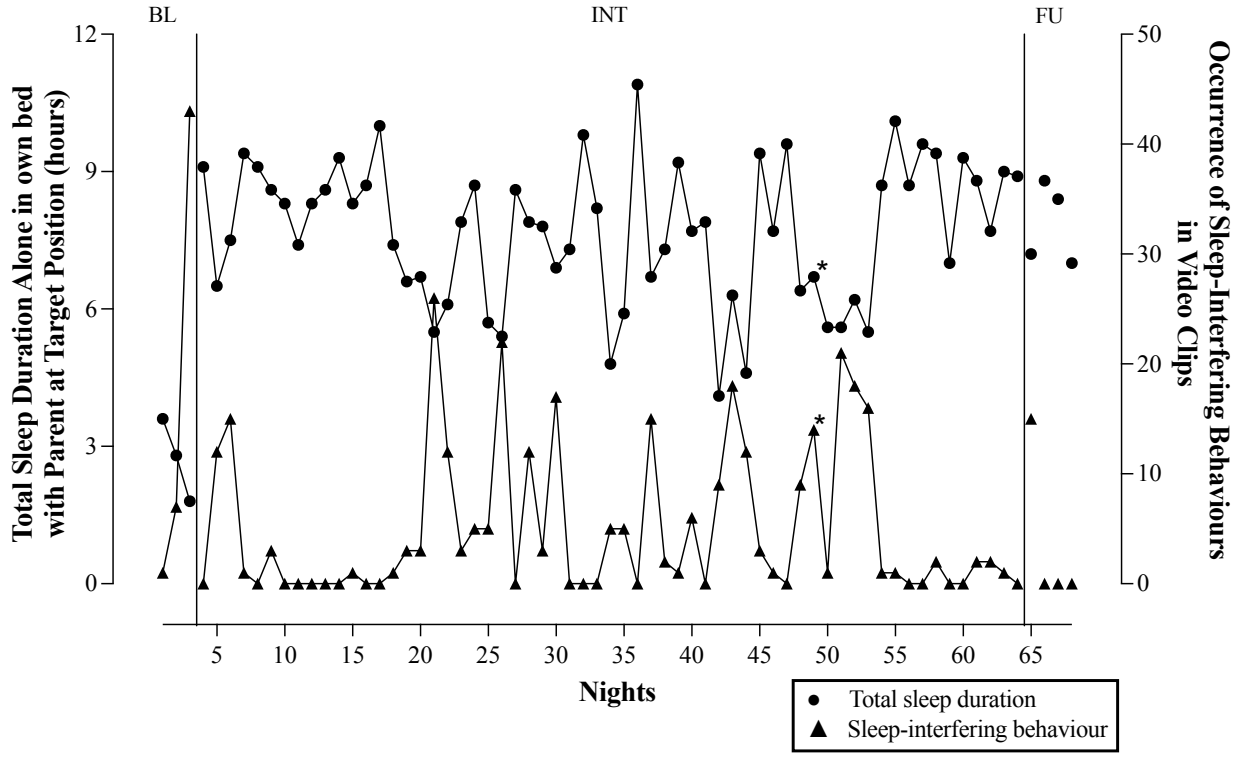
Total Sleep Duration Alone in own Bed and Sleep-Interfering Behaviours. Sonny's total sleep duration alone in own bed with parent at target position and frequency of sleep-interfering behaviours in D-Link video event recordings is depicted in Figure 3. In baseline, Sonny averaged 2.7 hrs of sleep (range, 1.8 hrs–3.6 hrs). During intervention, Sonny averaged 7.7 hrs of sleep (range, 4.1 hrs–10.9 hrs). An increase in total hours of sleep alone in own bed was observed from baseline to intervention. These results maintained during follow up probes with Sonny averaging 7.9 hrs of sleep (range, 7 hrs–8.8 hrs). Notably, Sonny was co-sleeping

with his parents during baseline. Sonny's mother began sleeping in her own bed on night 107 and continued to sleep there for the rest of intervention and follow-up probes.

Frequency of sleep-interfering behaviours during baseline averaged 17 instances per night (range, 1–43). During intervention, frequency of sleep-interfering behaviours decreased, averaging 5 instances per night (range, 0–26). During follow up, frequency of sleep-interfering behaviours averaged 3.8 instances per night (range, 0–15). Overall, the frequency of sleep-interfering behaviours decreased from baseline to intervention and these results generally maintained during follow-up probes. In general, during nights Sonny was sleeping less, the frequency of sleep-interfering behaviours increased.

Figure 3

Total Sleep Duration Alone in own Bed with Parent at Target Position and Sleep-Interfering Behaviours (Sonny)



Note. BL = baseline, INT = intervention, FU = follow up, * = parent sleeping in their own bedroom. Follow up probes were conducted at 2 weeks, 1 month, 3 months, and 6 months post-intervention.

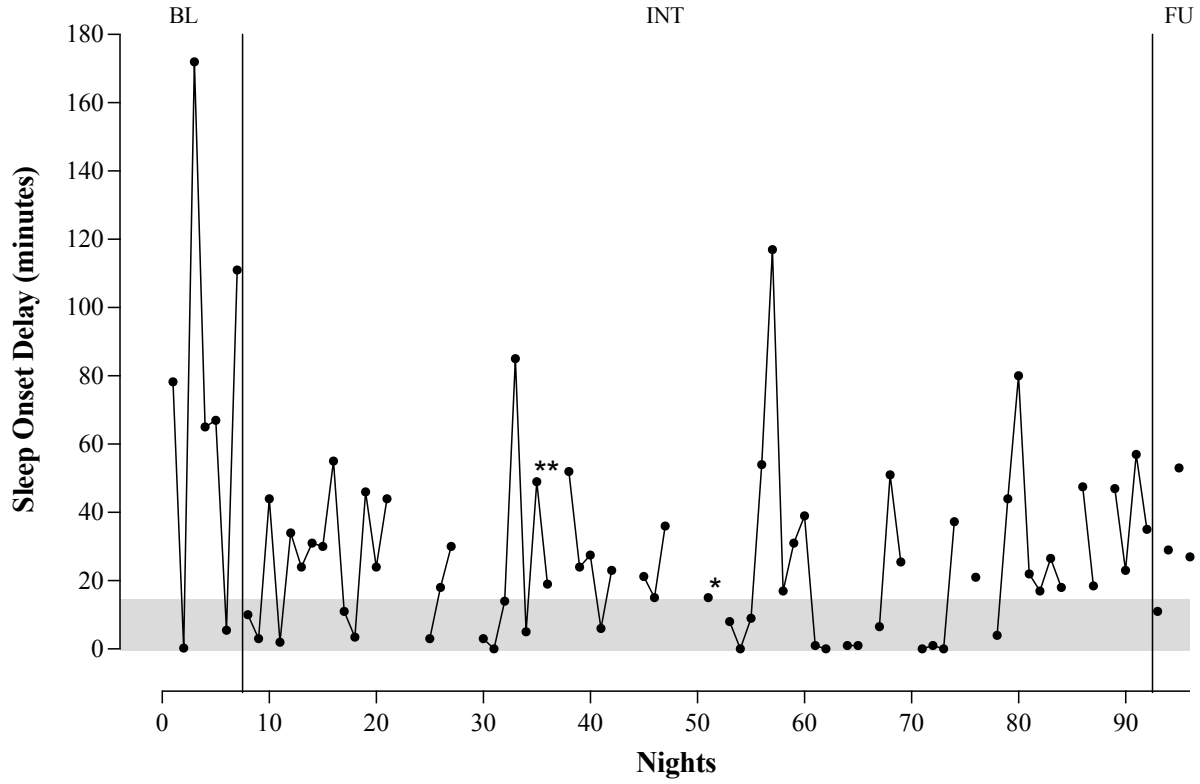
Hanna

Sleep Onset Delay. Hanna's sleep onset delay is depicted in Figure 4. During baseline, it took Hanna, on average, 71 mins to fall asleep (range, 0 mins–172 mins). During intervention, it took Hanna 25 mins, on average, to fall asleep (range, 0 mins–117 mins). During follow up, it took Hanna 30 mins, on average, to fall asleep (range, 11 mins–53 mins).

Further, Hanna was falling asleep within the ideal range for sleep onset for 29% of nights during baseline (*n*=7), 35% of nights during intervention (*n*=66), and 25% of nights during follow up (*n*=4). Overall, Hanna's sleep onset delay is variable during baseline and intervention; however, compared to baseline, the overall trend for sleep onset delay decreased during follow-up.

Figure 4

Sleep Onset Delay (Hanna)



Note. Grey shaded area = ideal sleep onset range (i.e., within 15 min). BL = baseline; INT = intervention; FU = follow-up probes; * = parent sleeping in their own bedroom; ** = target bedtime achieved. Follow up probes were conducted at 2 weeks, 1 month, 3 months, and 6 months post-intervention.

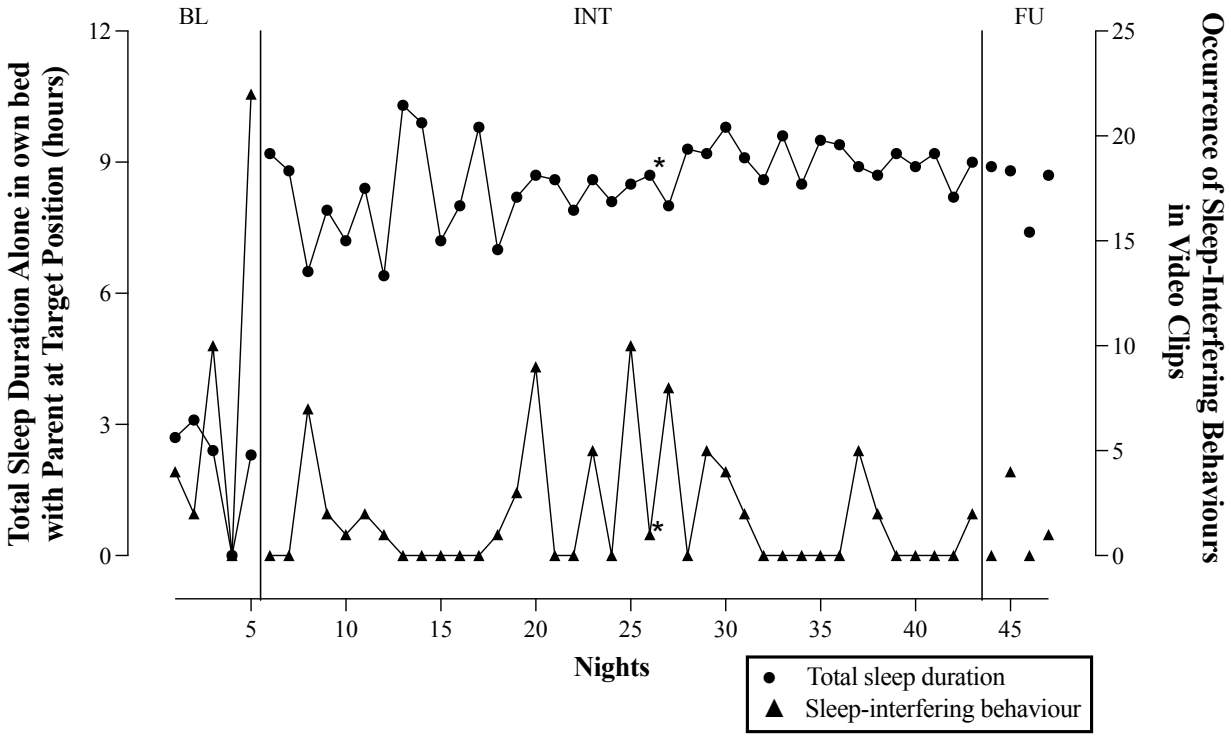
Total Sleep Duration Alone in own Bed and Sleep-Interfering Behaviours. Hanna's total sleep duration alone in own bed with parent at target position is depicted in Figure 5. In baseline, Hanna averaged 2.1 hrs of sleep (range, 0 hrs–3.1 hrs). A stable trend is seen in baseline. During intervention, Hanna averaged 8.6 hrs of sleep (range, 6.4 hrs–10.3 hrs). During follow up, Hanna averaged 8.5 hrs of sleep (range, 7.4 hrs–8.9 hrs). Total sleep duration alone in own bed while parent was at their target position increased from baseline to intervention. These

results generally maintained at follow up probes. Notably, Hanna was co-sleeping with her parents during baseline. Hanna's mother began sleeping in her own bed on night 51 and remained there for the rest of intervention and follow-up probes.

Hanna's frequency of sleep-interfering behaviours in D-Link video event recordings is also depicted in Figure 5. During baseline, frequency of sleep-interfering behaviours averaged 7.6 instances per night (range, 0–22). During intervention, frequency of sleep-interfering behaviours averaged 1.8 instances per night (range, 0–10). During follow-up probes, frequency of sleep-interfering behaviours averaged 1.3 instances per night (range, 0–4). Overall, a variable increasing trend can be seen in baseline, and although there is some variation during intervention, the overall trend is decreasing. These results maintained at follow-up probes.

Figure 5

Total Sleep Duration Alone in own Bed with Parent at Target Position and Sleep-Interfering Behaviours (Hanna)



Note. BL = baseline, INT = intervention, FU = follow up, * = parent sleeping in own room. Follow up probes were conducted at 2 weeks, 1 month, 3 months, and 6 months post-intervention.

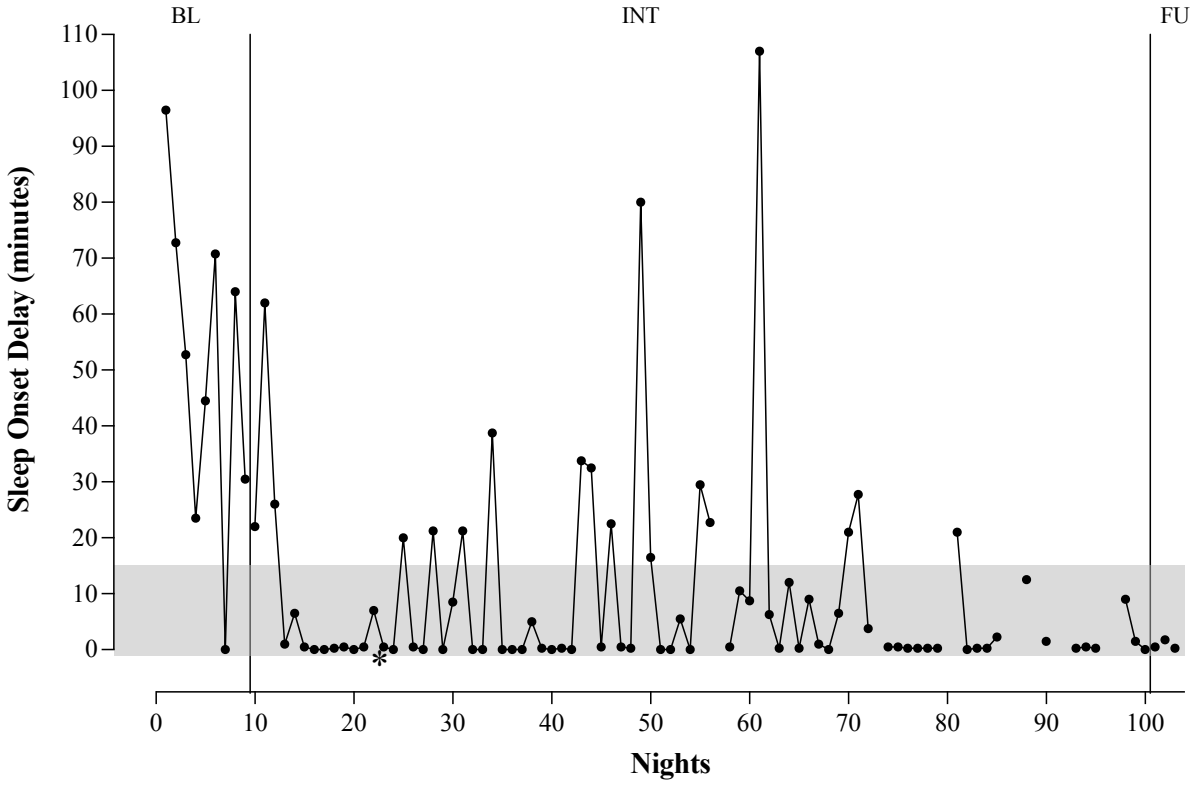
Finnegan

Sleep Onset Delay. Finnegan's sleep onset delay is depicted in Figure 6. During baseline, it took Finnegan, on average, 51 mins to fall asleep (range, 0 mins–96.5 mins). During intervention, it took Finnegan 9.5 mins, on average, to fall asleep (range, 0 mins–106 mins). During follow up, it took Finnegan 1 min, on average, to fall asleep (range, 0.25 mins–1.75 mins).

Further, Finnegan was falling asleep within the ideal range for sleep onset for 11% of nights during baseline (*n*=9), 78% of nights during intervention (*n*=81), and 100% of nights during follow up (*n*=3). During baseline, Finnegan's sleep onset delay is variable. During intervention, sleep onset delay is variable but results generally remained within the 15 min range. Further, the amount of variability in sleep onset delay from baseline to intervention decreased. These results generally maintained during follow-up probes.

Figure 6

Sleep Onset Delay (Finnegan)



Note. Grey shaded area = ideal sleep onset range (i.e., within 15 min). BL = baseline; INT = intervention; FU = follow-up probes; * = target bedtime achieved. Follow up probes were conducted at 2 weeks, 1 month, 3 months, and 6 months post-intervention. No data were collected for the final follow-up probe.

Total Sleep Duration Alone in own Bed and Sleep-Interfering Behaviours.

Finnegan's total sleep duration alone in own bed with parent at target position is depicted in Figure 7. In baseline, Finnegan averaged 6.2 hrs of sleep (range, 4 hrs–7.3 hrs). A variable trend is seen in baseline. During intervention, Finnegan averaged 7.2 hrs of sleep (range, 5.5 hrs–8.8 hrs). During follow up, Finnegan averaged 6.1 hrs of sleep (range, 0 hrs–8.9 hrs). There is some variability in the data from baseline to intervention for total sleep duration. These results

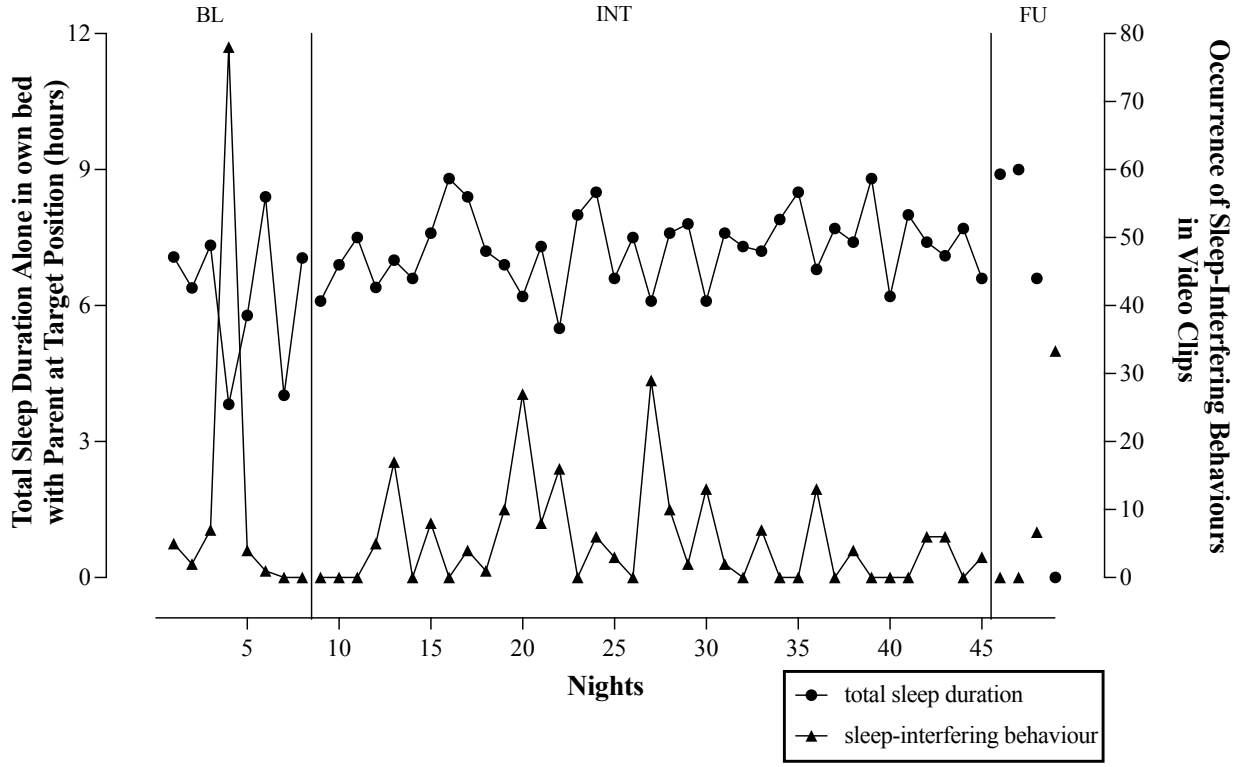
generally maintained for the first three follow up probes. Overall, visual inspection does not suggest a meaningful change in total sleep duration from baseline to intervention.

During the final follow up probe for Finnegan, his parent (i.e., Erin) reported that he had vomited after the BGN. Erin kept him out of his room in order to monitor his symptoms. As such, no sleep onset delay data were collected and total sleep duration alone in own bed was 0 hrs.

Finnegan's frequency of sleep-interfering behaviours in D-Link video event recordings is also depicted in Figure 7. During baseline, frequency of sleep-interfering behaviours averaged 12.1 instances per night (range, 0–78). During intervention, frequency of sleep-interfering behaviours averaged 5.4 instances per night (range, 0–29). During follow up probes, frequency of sleep-interfering behaviours averaged 1.5 instances per night (range, 0–5). Overall, the frequency of sleep-interfering behaviours was variable from baseline to intervention and these results generally maintained at follow up probes. Finally, visual inspection does not suggest a meaningful change in sleep-interfering behaviours from baseline to intervention.

Figure 7

Total Sleep Duration Alone in own Bed with Parent at Target Position and Sleep-Interfering Behaviours (Finnegan)



Note. BL = baseline, INT = intervention, FU = follow up, * = parent sleeping in own room. Follow up probes were conducted at 2 weeks, 1 month, 3 months, and 6 months post-intervention. At the 6 month follow up probe, Finnegan was taken out of bed due to illness and therefore, did not sleep in his own bed overnight.

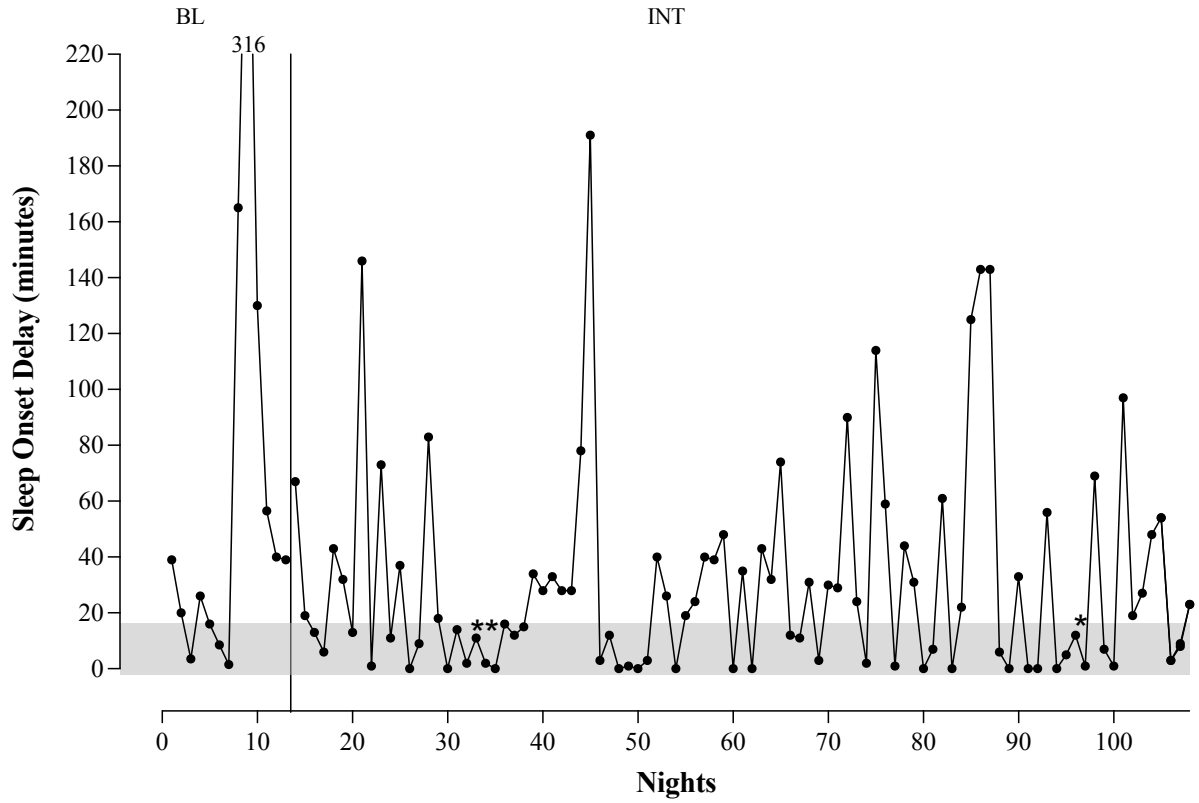
Carson

Sleep Onset Delay. Carson's sleep onset delay is depicted in Figure 8. During baseline, it took Carson 73 mins, on average to fall asleep (range, 1 min–316 mins). During intervention, it took Carson 31 mins, on average to fall asleep (range, 0 mins–191 mins).

Further, Carson was falling asleep within the ideal range for sleep onset for 23% of nights during baseline (*n*=13), and 45% of nights during intervention (*n*=95). The number of minutes, on average, that it took for Carson to fall asleep decreased from baseline to intervention, though these data were variable in baseline and intervention. Visual inspection does not suggest a meaningful change in sleep onset delay.

Figure 8

Sleep Onset Delay (Carson)



Note. Grey shaded area = ideal sleep onset range (i.e., within 15 min). BL = baseline; INT = intervention; * = parent sleeping in their own bedroom; ** = target bedtime achieved. Due to participant withdrawal, no follow up probes were conducted.

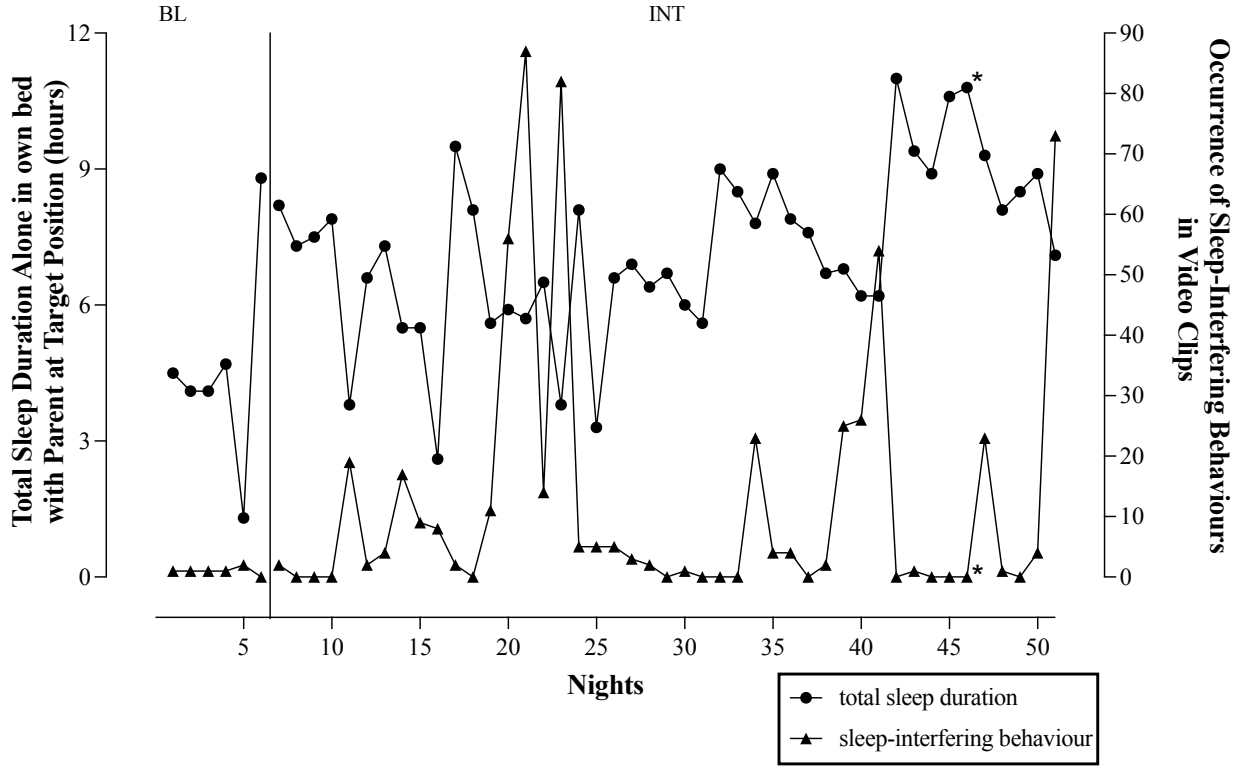
Total Sleep Duration Alone in own Bed and Sleep-Interfering Behaviours. Carson's total sleep duration alone in own bed with parent at target position is depicted in Figure 9.

During baseline, Carson averaged 4.6 hrs of sleep (range, 1.6 hrs–8.8 hrs). During intervention, Carson averaged 7.2 hrs of sleep (range, 2.6 hrs–11 hrs). Total sleep duration alone in own bed with parent at target position was variable during intervention, however, the average number of hours in own bed did increase from baseline. Notably, Carson was co-sleeping with his parents during baseline. Carson's parents began sleeping in their own bed on night 96 and remained there for the rest of intervention.

Carson's frequency of sleep-interfering behaviours in D-Link video event recordings is depicted in Figure 9. During baseline, frequency of sleep-interfering behaviours averaged 1 instance per night (range, 0–2). During intervention, frequency of sleep-interfering behaviours averaged 13 instances per night (range, 0–87). Overall, frequency of sleep-interfering behaviours increased from baseline to intervention.

Figure 9

Total Sleep Duration Alone in own Bed with Parent at Target Position and Sleep-Interfering Behaviours (Carson)



Note. Note. BL = baseline, INT = intervention, * = parent sleeping in own room. No follow up probes were conducted.

Summary of Child Results

In summary, three of four children were co-sleeping with their parents during baseline (i.e., Sonny, Hanna, and Carson). Co-sleeping was eliminated for all three children by the end of the intervention (i.e., parents were sleeping in their own rooms). The mean number of nights for parents to sleep in their own room from the start of intervention was 77 nights (range, 44–104). In addition, the mean number of nights for children to reach their target bedtime from the start of intervention was 27 nights (range, 14–44). A summary of child results is presented in Table 18.

Table 18

Summary of Child Results

	P1; Sonny		P2; Hanna		P3; Finnegan		P4; Carson	
	BL	INT	BL	INT	BL	INT	BL	INT
Co-sleeping with parent	Yes	No	Yes	No	No	No	Yes	No
Total Nights of INT	-	140	-	85	-	91	-	95
Parent Sleeping in own Room*	-	104	-	44	-	-	-	83
Target Bedtime Achieved*	-	44	-	28	-	14	-	20

Note. BL = baseline; INT = intervention. * = the number of nights from the start of intervention to achieve these goals are indicated. A cell with a dash indicates not applicable.

Discussion

The purpose of this study was to evaluate: (a) if the combination of a BST and nighttime coaching program provided via telehealth improved parents' treatment fidelity, decision-making accuracy, and stress levels, (b) if parents found their child's behaviour analytic assessment and sleep intervention acceptable and reasonable, and (c) if a telehealth-based parent training intervention improved child sleep outcomes.

Parent Outcomes

Results indicate that all participating parents implemented their child's behavioural sleep intervention with good treatment fidelity. Further, high levels of fidelity were maintained while nighttime coaching was systematically faded, and results generally maintained during 3- and 6-month follow-up probes. As such, these results suggest that a telehealth parent training and coaching model can be used to support parents of children with ASD to implement sleep

interventions with high levels of treatment fidelity and that parents can continue implementing sleep interventions with good treatment fidelity once support has been systematically faded. Results also provide emerging evidence that parents can use mastery criteria to make treatment decisions, provided they receive daily feedback. Further, the sleep intervention did not appear to increase or decrease parental stress levels. We hypothesized that improved child sleep habits might reduce parent stress. However, PSI-4 SF results pre-intervention were within normal ranges. For this reason, reductions in parent stress post-intervention would not be expected. In fact, it is encouraging that parent stress levels remained within normal ranges and parents did not report increased stress given the intensity (e.g., every night, over several months) and nature (e.g., sleeping in child's room, systematic fading of bedtime) of the intervention. Finally, parents reported that their child's individualized behaviour analytic sleep intervention was acceptable and effective. Parents also indicated their willingness to continue the sleep intervention and generally agreed that the intervention was feasible; parents moderately disagreed to statements about potential disadvantages resulting from the intervention and potential disruption(s) to the family to carry out the intervention. Overall, these results provide encouraging evidence for the use of a telehealth BST and coaching model to train parents of children with ASD to implement behavioural sleep interventions.

Child Outcomes

Child outcomes were analyzed in the context of parent-identified sleep goals from the SATT (see Table 9). First, one parent wanted to establish a bedtime routine (i.e., Zoya-Sonny) while another wanted to change the location of their bedtime routine (i.e., Erin-Finnegan). Although it is not depicted on the graphs, during baseline, Sonny was not following a consistent bedtime routine. His bedtime routine consisted of either playing video games or watching videos

on the computer or iPad, in his bed, with or without his parents, for a varied amount of time, and no bid goodnight. During intervention, the sleep team helped his parents establish a steady bedtime routine that consisted of between 5 to 10 mins of computer or iPad time, at his desk with a parent, before removing the device from the bedroom, and bidding goodnight. During intervention, Sonny was able to follow a bedtime routine and demonstrated minimal non-compliance in following this routine. On the other hand, Finnegan was following a consistent bedtime routine, but his bedtime routine was completed across two locations: downstairs and upstairs. During baseline, Finnegan's bedtime routine consisted of watching the iPad or television for up to an hour, both downstairs and upstairs. During intervention, the sleep team helped his parents establish a steady bedtime routine that consisted of 15 mins of quiet cuddle time upstairs, before his parents' bid goodnight and left the room.

Three of four parents wanted their children to fall asleep independently without parental or sibling presence (i.e., Zoya-Sonny, Miya-Hanna, Mandy-Carson) and all four parents wanted their children to stay asleep in their own beds, independently, throughout the night. During baseline, three children (i.e., Sonny, Miya, and Carson) were co-sleeping with their parents immediately after going to bed and after any night wakings. By the end of intervention, co-sleeping was discontinued for these three children. In other words, by the end of intervention parents were able to bid their child good night and leave the bedroom, and children were observed to reliably fall asleep independently without parental presence. Finally, two out of four children (i.e., Sonny and Hanna) generally stayed asleep throughout the night. In contrast, Finnegan's sleep activity did not change, and Carson's remained variable. Overall, a number of parent-identified sleep goals were achieved. This may help explain the positive parent ratings on the modified version of the TARF-r.

Child outcomes were also analyzed using visual inspection. For the most part, the results support behaviour-analytic sleep interventions to address sleep challenges in children with ASD, as evidenced by general improvements in sleep onset delay, total sleep duration, and–to a lesser extent–occurrences of sleep-interfering behaviours. More specifically, sleep onset delay improved for two participants (i.e., Sonny and Finnegan) but remained variable for the other two participants (i.e., Hanna and Carson). Our goal range for sleep onset delay to occur was set at 15 mins, but previous research has used goal ranges between 15 and 30 mins (e.g., Jin et al., 2013). Children with ASD may have longer settling periods given the multi-factorial (i.e., amalgamation of neurobiological, medical, behavioural, and cultural processes) nature of sleep challenges (Souders et al., 2017). Therefore, increasing the goal range for sleep onset delay to occur may be more appropriate given the variability in some children's sleep onset. Further, two of the four children (i.e., Sonny and Carson) were administered melatonin regularly throughout the study. Although previous studies have eliminated the use of supplements such as melatonin or Benadryl at bedtime (e.g., Jin et al., 2013), this was not a requirement of the present study. Abnormal melatonin levels in children with ASD have been noted (Souders et al., 2017), so supplemental support at bedtime may be beneficial for some children. Future research should continue exploring settling periods for children with ASD and the role of supplements in addressing sleep challenges.

Further, total sleep duration increased for two of four participants (i.e., Sonny and Hanna). In general, total sleep duration improved for the children whose sleep-interfering behaviours were socially mediated whereas total sleep duration did not improve for the child (i.e., Finnegan) whose sleep-interfering behaviours was non-socially mediated. Again, these results may speak to the multi-factorial nature of sleep challenges in children with ASD and may

indicate that some children require different intervention approaches or a combination of behavioural and non-behavioural interventions (e.g., pharmacological interventions) to address their sleep challenges (Cuomo et al., 2017). Future research should explore interventions to address sleep challenges in children whose sleep-interfering behaviours are maintained by non-socially mediated consequences.

Interestingly, despite other areas of improvement, sleep-interfering behaviours did not appear to improve for most participants. This is somewhat difficult to understand given the aforementioned improvements in sleep onset delay and total sleep duration, as well as the positive parental social validity ratings. Further, the lack of improvement in sleep-interfering behaviours stands in contrast with prior studies (e.g., Jin et al., 2013; Linnehan et al., 2022; McLay et al., 2019b; van Deurs et al., 2021). This may be explained, in part, by the decision to combine all topographies of sleep-interfering behaviours into a single, overarching, definition of sleep-interfering behaviours. For example, Jin et al. (2013) separated sleep-interfering behaviours into stereotypy, sitting or standing, out-of-bed, and vocalizations. The researchers also collected data on the duration of each of these topographies, rather than frequency. As such, the measurement system used in this study may not have been sensitive to changes in duration or other dimensions of behaviour that could have improved. Further, some behaviours are likely more disruptive to families (e.g., leaving the bedroom or calling out to parents) than others (e.g., standing in bed). The definitions within the present study did not discriminate between these more or less disruptive behaviours and as such, reductions in more disruptive behaviours were likely not captured over time. Additionally, in baseline, three of four children co-slept in their own bed with parents which likely reduced the establishing operation for parent attention and therefore reduced the need to engage in sleep-interfering behaviours. Finally, in baseline, those

same children completely left their bedrooms for extended periods of time (i.e., the entire night), and as such, baseline data on sleep-interfering behaviours may reflect a briefer observation period (e.g., 2–3 hrs) versus the longer observation periods (e.g., 7–10 hrs) during intervention and follow-up. Sleep-interfering behaviour results should be interpreted in the context of these measurement limitations; there was no meaningful change in sleep-interfering behaviours despite children sleeping for longer periods of time, alone in their own bed. Said another way, the fact that there was not a significant increase in sleep-interfering behaviours, despite an increase in the observation period (as evidenced by the increase in total sleep duration), may in fact signal an improvement not necessarily depicted on the graphs. Nevertheless, more research is needed to not only determine effective approaches to decrease sleep-interfering behaviours but also practical approaches to measure sleep-interfering behaviours.

Finally, these results generally maintained at follow-up, suggesting that improvements in sleep outcome measures maintain for periods of up to 6 months. Previous studies have demonstrated improvements of up to 2 months (Linnehan et al., 2022) and 3 months (Jin et al., 2013; McLay et al., 2019b). Other reviews have noted mixed results for the length of follow-up (between 1 and 6 months; Kirkpatrick et al., 2019; Pattison et al., 2020). Given the persistent and multi-factorial nature of sleep challenges in children with ASD, more research is needed to not only assess the longitudinal impacts of these interventions, but also the durability of behavioural sleep interventions.

Strengths

There are many strengths to the present study. First, this study measured treatment fidelity outcomes over the course of the sleep intervention. Studies that report treatment fidelity outcomes are noticeably absent in the behavior analytic literature in general (Falakfarsa et al.,

2021; McIntyre et al., 2007) and in the behaviour analytic sleep literature specifically (Kirkpatrick et al., 2019; McLay et al., 2021). This is concerning given that parents of children with sleep issues are likely lacking sleep themselves (Meltzer & Mindell, 2007) and as such may be at a higher risk for poor implementation fidelity. Further, behavioural sleep interventions are complex, often involving many different antecedent and consequent strategies that parents are required to implement. Parents are not only required to change their own behaviour in terms of setting up a bedtime routine and responding to their child, but also follow the plan with consistency throughout the night, all while the parent, themselves, is tired. Without appropriate parent coaching and treatment fidelity measures it is difficult to know whether parents are implementing sleep interventions as prescribed. This study makes an important contribution to the sleep intervention literature by reporting on parent treatment fidelity directly.

Another strength of this study is that it assesses child and parent outcomes up to 6 months post-intervention. As previously mentioned, follow-up for child sleep outcome measures varies but follow-up for parent treatment fidelity is non-existent (e.g., Jin et al., 2013; McLay et al., 2019b).

An additional strength of the present study is the development of a systematic approach to parent training and coaching involving a dense level of support at the start. Within this study, parents were more likely to respond below 80% during the first step (i.e., one night of coaching over a minimum period of four nights) of the nighttime coaching schedule before responding stabilized, above 80%, within and across parents, suggesting that more frequent support is needed during the initial stages of an intervention. This level of support should not be overlooked as previous research suggests that high levels of fidelity at the start of an intervention may be particularly important (Stephenson & Hanley, 2010). Further, once parents began achieving

higher levels of fidelity (i.e., ≥80%), support was systematically faded such that parents maintained those outcomes. Although Zoya required a booster session during coaching and fading, she continued to maintain an average level of fidelity above 80% during intervention, fading, and follow-up.

Additionally, to my knowledge, this study was the first to assess parents' daily decision-making accuracy with sleep interventions. Previously, studies have assessed parents' ability to make decisions regarding strategies to implement at home to address sleep challenges in typically developing children (e.g., Malow et al., 2014), but have not assessed the daily decisions parents have to make such as bedtimes, their position in the room, and whether the child earned his or her reward in the morning. This approach may increase self-efficacy and reduce dependence on others for support when families fall out of routine (e.g., late evening, birthday party).

Although this intervention may appear lengthy since the intervention period ranged between 85 and 140 days, within the sleep literature, it is not uncommon for the length of the intervention period to vary significantly. For example, Linnehan et al. (2022) sleep intervention was 65 days for one participant while Jin et al. (2013) sleep intervention was between 20 to 30 nights for three participants. Given that all parents in the present study had indicated that their child's sleep problems had persisted for several months to years (i.e., between 1–6 years) and all children ceased co-sleeping and improved on at least one additional sleep outcome measure, a 12-week intervention seems reasonable.

Additionally, all components of this study were completed via telehealth. To my knowledge, this is the first study that explored a combined BST and nighttime coaching approach, delivered via telehealth, to train parents to implement and monitor their child's

behaviour-analytic sleep interventions. McLay et al. (2020) discussed the need for studies to explore the effects of a synchronous coaching approach, delivered via telehealth, to address sleep challenges in children. Taken together, this is not only a beneficial approach for the family but also for clinicians and researchers as it provides a potential way for them to support families remotely. Further, since nighttime coaching was systematically faded by the end of the study, this study may provide a meaningful way to approach the issue of how much implementation support is required and thus may reduce the level of support professionals provide overall, during both regular business hours and evenings. Telehealth allows families access to a wider variety of services that may not be available locally. For example, the furthest distance between a sleep coach and participating family was approximately 120 km. This adds to the growing body of literature that supports the benefits of telehealth services (e.g., Lee et al., 2015; Tomlinson et al., 2018). This study also used various forms of technology (e.g., d-link cameras, event recordings, iPads). This combination may create a more efficient approach to coaching and monitoring sleep interventions. Within this study, sleep outcomes were measured using objective data (i.e., motion and sound detection). Few studies have assessed whether motion and sound detection cameras can be used to monitor children's sleep (e.g., Lesser et al., 2019; McLay et al., 2021; van Deurs et al., 2021). The use of event recordings and weekly versus daily measurement may be more practical than the use of continuous recording (Lesser et al., 2019). Further, Lesser et al. (2019) stated the need for more research in the area of event recordings for decision making (i.e., treatment monitoring) and as such, this was an additional strength of the present study.

Limitations

This study is not without limitations. Parents were aware that they were being observed and data were being collected on their behaviour, and this may have altered their behaviour.

Nevertheless, research suggests that parents may generalize their skills from coaching trials to independent trials (non-coaching trials; Suess et al., 2014). It may be beneficial to explore parent's treatment fidelity during non-coaching nights in order to detect the presence of an observer effect.

Further, across all families, technical issues with the cameras existed, which occasionally resulted in sleep coaches collecting sleep outcomes measures (e.g., sleep onset delay) using continuous video recording via the remote viewing option on D-Link or parent sleep logs in order to inform daily treatment decisions. Previous research indicates acceptable levels of agreement between parent sleep logs and continuous video recordings (e.g., Jin et al., 2013), and generally acceptable levels of agreement between parent sleep logs and event recordings (e.g., McLay et al., 2021; van Deurs et al., 2021). As such, correspondence between parent sleep logs and event recordings should continue to be investigated. Further, mean IOA scores for parent and child measures were above 85%. However, there were unusual events (e.g., blurry event recording) that may have contributed to low agreement for some sessions. These low scores were addressed through additional training for coders when possible and coding a larger number of sessions to strengthen confidence in the data.

Additionally, parent stress results were only reported for two of four parents, which made comparisons difficult. We hypothesized that if children were sleeping better there would be a reduction in parent stress levels; however, this was not the case. This may be because the PSI-4-SF is not sensitive to stress associated with sleep difficulties or it could be that the nature of child behaviour changes does not impact stress. However, it is promising to see that although parents were implementing a complex intervention that the two parents who did complete the PSI-4-SF indicated that participating in this program did not increase their stress levels. Nevertheless,

more research should be done to evaluate the relationship between parents implementing complex interventions such as a behavioural sleep intervention, parent stress levels, and child behaviours.

The decision was made to use a combination of daily (e.g., sleep onset delay) and weekly (e.g., occurrences of sleep-interfering behaviours and total sleep duration) data. Although this may be a more practical approach to progress monitoring, it is not without its limitations. Specifically, less frequent measurement may not provide an accurate overall picture of sleep trends. Across the sleep literature, there are different approaches to collecting data to assess changes in child outcomes. For example, some studies may collect probe data at two time points (e.g., Schlarb & Brandhorst, 2012) while others may collect nightly data (e.g., Jin et al., 2013; Linnehan et al., 2022). Further, the measurement system for sleep-interfering behaviours in this study was not sensitive to changes in the behaviour over time. Duration or rate of sleep-interfering behaviours may have been more sensitive to potential changes in sleep-interfering behaviours. More research should be conducted to identify the type and amount of data required to accurately monitor behavioural sleep interventions.

Further, given that the SATT is an indirect method of assessment, it may be less reliable than direct methods of assessments (i.e., functional analysis) in determining the maintaining consequences of sleep-related behaviours (Cooper et al., 2020). Future researchers should consider the potential benefits, and possible practical limitations, of more direct methods, in order to accurately identify the function(s) of relevant sleep interfering behaviours.

Finally, three of four participants identified as Caucasian, and as such, there is still a need to assess the acceptability of behaviour analytic sleep interventions within other cultures that may have different sleep practices. Further, all participants were two-parent families and with a

preference for solo sleeping; therefore, more research is required on how best to support children and parents with different sleep preferences and family structures.

Future Research

First and foremost, treatment fidelity measures should be collected using objective measures within the sleep literature. It is not enough to compare parent notes describing what they did to the prescribed intervention protocol to measure treatment fidelity–objective measures should be used. The lack of treatment fidelity reporting limits our ability to interpret the relationship between behavioural sleep interventions and child outcomes. To this point, future researchers should continue to explore if there are types of procedures that parents find more or less difficult and more or less acceptable to implement. In fact, Reid et al. (1999) found that parents were more reluctant to implement extinction-based procedures to address sleep challenges, often leading to participant dropout.

There is also no clear indication of how much support parents may require following an initial training; previous studies have varied the nature of ongoing support provided to parents following an initial training (e.g., Nuta et al., 2021). Therefore, it is not surprising that the nature of implementation support within sleep interventions varies as well (Pattison et al., 2020). Future researchers should continue to investigate approaches to parent training and ways to successfully fade support while maintaining both parent and child outcomes. Further, some components of behavioural sleep interventions may be harder for parents to implement. As such, future researchers should conduct error analyses in order to better support parents (e.g., identifying areas to provide additional training and coaching).

Further, the level of *fidelity* or *consistency* that is required to maintain child outcomes has not been thoroughly explored across the behaviour-analytic sleep literature. Some studies have

explored the impact of treatment fidelity errors (i.e., errors of omission and commission; St. Peter Pipkin et al., 2013) but this has not been explored within sleep interventions. Similarly, it is widely accepted that inaccurate implementation of extinction-based procedures may render interventions ineffective (e.g., Kodak & Piazza, 2008; St. Peter Pipkin et al., 2007); however, the impact of improper use of extinction-based procedures during sleep intervention specifically is unknown. As mentioned, parents are likely at a higher risk of conducting treatment fidelity errors when they are lacking sleep themselves and as such, there is a need for future researchers to explore these issues, within the context of sleep.

Additionally, although Zoya's sleep team began fading decision-making support during the fading period, decision-making support was not faded for the other three participants. Fading decision-making support may provide an additional means to reduce the resources that are often required to implement, monitor, and supervise behaviour-analytic interventions. Future researchers should continue to investigate whether parents can accurately make decisions using children's intervention plans, mastery criteria, and the data they collect.

Finally, families also suggested that sleep interventions should be more flexible in order to be more responsive to the everyday realities of family life. Previous literature notes the importance of collaborating with parents when designing not only parent-led interventions but parent-led sleep interventions (e.g., Jin et al., 2013; Kirkpatrick et al., 2019; McLay et al., 2020; McLay et al., 2021; Pattison et al., 2020). Further, collaboration is associated with increased treatment adherence (i.e., following interventions outside of clinical oversight; Moore & Amado, 2021). Although the sleep team involved parents in the selection of treatment approaches and accommodated minor treatment disruptions (e.g., parents working later one evening or a birthday party), it might be worth exploring ways in which sleep interventions and coaching schedules

could incorporate major disruptions such as, longer vacations, or consistently later weekends. Such contextual and environmental variables are important to consider when designing parent-led interventions.

Conclusion

Sleep facilitates healthy development. The need for adequate sleep each and every day, regardless of age, cannot be understated. The present study approached the issue of addressing sleep challenges while simultaneously evaluating parent treatment fidelity. Results indicated that treatment fidelity outcomes increased for all parents, and this generally maintained at follow-up. The study also included a unique component that is often omitted from similar studies, parents' decision-making accuracy. Decision-making accuracy increased from pre- to post-test and these results maintained during the intervention. The hope is that this component empowers parents to manage sleep challenges on their own, and to effectively adapt to new challenges. Further, PSI-4-SF scores did not increase or decrease post-intervention for the two parents who submitted their questionnaires. This is a positive result considering parents were involved in a complex sleep intervention, over a 12-week period, and their reported stress levels did not increase. Further, sleep outcome measures for the children, including the creation of bedtime routines and elimination of undesired co-sleeping, indicated general improvements and these results tended to maintain up to 6 months post-intervention. The results provide support for the durability of the prescribed sleep intervention.

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Appendix A

Recruitment Poster

Brock University

Research Study:

Evaluation of Behaviour Analytic Assessment and Intervention to Address Sleep Problems in Young Children with Neurodevelopmental Disorders

Is your child:

- Between 3 and 9 years of age?
- Diagnosed with a neurodevelopmental disorder (e.g., autism spectrum disorder, intellectual/developmental disability, etc.)?
- Demonstrating sleep related issues such as difficulty falling or staying asleep, frequent night waking, noncompliance with bedtime routines, or challenging behaviours during the bedtime routine, that do NOT have a medical basis?

Sleep problems such as those described above are common in children with neurodevelopmental disorders and can lead to diminished sleep and associated challenging behaviours. Behavioural interventions may be helpful in reducing these behaviours. However, more research is needed to evaluate the effectiveness of home-based, parent-led interventions for sleep problems offered through a telehealth format. Clients at Kalyana Support Systems are eligible to participate in this research study, offered in collaboration with the Koudys lab at Brock University. This study is aimed at training parents to monitor children's sleep problems and implement behavioural strategies, with the aim of reducing sleep problems and associated challenging behaviours.

If you are interested in learning more about the study, please contact us jkoudys@brocku.ca or 905-688-5550 ext. 6706.

This study has been reviewed and has received ethics clearance through the Brock University Research Ethics Board (file # 17-375-KOUDYS).

PRINCIPAL INVESTIGATOR

Dr. Julie Koudys, C. Psych., BCBA-D
Assistant Professor
Department of Applied Disability Studies
Brock University
jkoudys@brocku.ca

Appendix B

Parent Information Letter

Title of Study: Evaluation of Behaviour Analytic Assessment and Intervention to Address Sleep Problems in Young Children with Neurodevelopmental Disorders

Principal Investigator: Dr. Julie Koudys, C.Psych., BCBA-D
Assistant Professor
Department of Applied Disability Studies, Brock University

Dear Parents,

We are inviting parents to participate in a research study we are doing to better understand how to treat sleep problems in children with neurodevelopmental disorders. This intervention will be based on the principles of applied behaviour analysis. The intervention will be implemented by parents in their own homes, with their own children, with support from clinicians and researchers using telehealth. The research team will conduct training sessions using an online video conferencing website (e.g., VSee). Participation in this study will require a stable, password protected internet connection and a device that may be used for online training (e.g., smartphone, tablet, computer).

As you may know, many children with neurodevelopmental disorders, such as intellectual disability and ASD (40-80%) exhibit sleep problems. These problems can negatively affect children and their families and may be linked to higher rates of other problem behaviours. Even though some pediatricians may recommend either no treatment (waiting for the problems to resolve themselves) or medication, other research suggests that behavioural strategies can effectively resolve sleep problems.

What is involved in participation?

If you would like to participate, a member of our research team will arrange a virtual meeting using VSee to discuss details of the study. At this meeting you will meet with a Research Assistant from Brock University. The assistant will answer any questions you may have and seek your consent to participate, and email a link providing you access to the informed consent form. You will also be asked to complete a short questionnaire and provide information about yourself and your child, the types of sleep problems that he/she has, and any other pertinent information to the study (e.g., medications). This meeting should take approximately 1 to 1 ½ hours.

Next, our Research Team will conduct an online assessment of your child's sleep, in order to determine the best course of treatment for your child's particular sleep problems. As a component of this assessment, you will be asked to complete an interview about your child's sleep habits. This meeting should take approximately 1 to 1 ½ hours. Following this assessment, we will ask you to complete a nightly sleep log in order for us to better understand your child's sleep difficulties.

Next, you will participate in three group-based trainings that will focus on teaching you applied behaviour analysis strategies for your child's sleep intervention. These trainings should take approximately 1 to 1 ½ hours.

Finally, a behavioural intervention will be designed for your child based on the results of the assessment and an analysis of the sleep log you complete. You will then be trained online to implement the intervention with your child, in your own home. Your Clinical Team (i.e., a BCBA from Kalyana Support Systems) and trained research assistants will meet with you online several times per week to assist you with the intervention and to collect data. With your consent, this may involve scheduled online observation sessions at bedtime, ongoing support using technology such as video chat/video conferencing technology, or scheduled phone calls. Some of your son or daughter's nightly sleep will be videotaped in order for researchers to collect data related to your child's sleep. With your consent, the Research Team will also record sessions (using VSee and/or dlink) observing you and/or your child in your home in order for researchers to collect data related to your training and your ability to implement the intervention. You will also be required to complete nightly sleep logs for the rest of the intervention.

During this research, your child may continue to receive their usual treatment at his/her usual ABA clinic. However, we ask that parents do not participate in any form of training related to sleep.

Who will be involved in my child's sleep intervention and the research project?

If you decide to participate in the research project on sleep intervention, you will be assigned a Research Team. This team will involve the Primary Investigator, a Research Coordinator, and Research Assistants. Members of your Clinical Team will also be involved in the research project, as this research project is being conducted as part of sleep intervention services offered through Kalyana. As a client of Kalyana Support Systems, your child and family will continue to receive all usual treatments from their assigned Clinical Team, while the project is underway.

The *Primary Investigator* is Dr. Julie Koudys. Dr. Koudys may also be your child's Clinical Supervisor. Should you choose to participate in the study Dr. Koudys will continue to provide your child with ongoing Clinical Supervision as per your child's Service Agreement. In addition, Dr. Koudys will schedule separate meetings to discuss your child's and your family's progress in the research project. These meetings are separate from your child's clinical supervision and will focus only on your child's sleep intervention/research involvement.

The *Research Coordinator* will be one of the senior staff members at Kalyana who is NOT currently affiliated with your child's clinical team. This person will only be involved in your child's and your family's sleep intervention/research involvement. You will continue to receive supervision from your currently assigned senior staff member at Kalyana Support Systems for the oversight of your child's IBI/ABA treatment.

Research Assistants will be Brock University graduate students under the supervision of your child's clinical supervisor and the primary investigator, Dr. Koudys. Research assistants will be

involved in training you on your child's sleep intervention (as described above) with the support of the research team. They will also collect and analyze data related to your child's and family's sleep intervention/research involvement and provide general support to the project.

Risks and Benefits

A possible risk associated with this study is decreased sleep for both you and your child, as your child gets used to the new protocol during sleep time. Diminished sleep may interfere with your daily functioning. However, we anticipate this will only last for a short period of time, and that the sleep problems will be reduced quickly. If this is not the case, the treatment will be altered to address any new challenges. In addition, it is not uncommon to see an initial increase in a behaviour that has been targeted for decrease. If your child's target behaviour includes aggression or disruptive behaviour, this may include an increase in the rate/intensity of the behaviour. To protect against this, safety measures will be implemented to enhance the safety of your child, and all others involved in the study (i.e., you, the clinical team, and the researchers).

It is also possible that you may feel some discomfort during the initial stages of the project as you learn a lot of new information, are asked to implement new strategies with your child, and participate in group-based trainings. We will try our best to provide as much support as you need to help you succeed, and to help you achieve the best results possible.

As with any training involving groups, it is possible that you may disclose private information about yourself and/or your child. To reduce the risk to privacy/confidentiality, all individuals (principal investigator, co-investigators, research assistants, and parents) will be reminded of the importance of respecting each other's privacy and not sharing confidential information about others. All participants and researchers will also sign a confidentially form.

Possible benefits of participating in this study may include a reduction in your child's sleep problems and an increase in your ability to manage your child's sleep difficulties. However, these benefits are not guaranteed, and it is possible that no improvement in yourself or your child's sleep problems will be observed.

Voluntary

Involvement in this study is completely voluntary and you are under no obligation to participate. If you choose not to participate, or later withdraw, this will have no impact on your relationship with Brock University, the primary researcher, or any of the co-investigators, and will have no impact on the services you are currently receiving, or will receive, from Kalyana Support Systems.

Consent

For the initial online meeting, you will have the chance to ask any questions you have and you will be asked to review a consent form which outlines many of the same points that are in this letter. If and when you volunteer to participate in the study, the research assistant will provide you with a link to a secure online folder (e.g., Sync). The folder will contain an online copy of

the informed consent form, which will require your signature. Only you and the research team will have access to the folder. If you consent to participate, then we will provide additional information to you about the study and all that is involved.

Confidentiality and Privacy

Great care will be taken to maintain your and your child's privacy throughout the study. When presenting or publishing the results of this study, we will never use your son/daughter's name or any other identifying information. Information shared with us will remain confidential. However, as you know, confidentiality can only be guaranteed to the extent allowed by law. The rare exceptions involve serious matters such as child abuse, sexual abuse by a health care provider, concern that someone may be planning to hurt themself or someone else, and legal situations. Study materials such as the questionnaires you complete, video footage, and raw data associated with your child's sleep progress will be stored in a cloud-based storage system called "Sync," which provides end-to-end encryption, completely safeguarding data from unauthorized access, and allows the research team to ensure data privacy compliance. Our databases on computers never include names, only a code number or a pseudonym. All information collected in the study will be stored securely, in a locked cabinet in a locked office at Brock University and will only be accessed by people directly involved in the research under the supervision of Dr. Koudys. Files will be kept for 5 years; following this they will be securely destroyed. A copy of the raw data collected on your child's sleep habits will also be kept in your child's clinical file (according to relevant record keeping practices as described in your child's service agreement).

This study has been reviewed by, and received clearance from, the Brock University Research Ethics Board (17-375). If you have any concerns about the ethics or consent process, you may contact Lori Walker, Manager of Research Ethics, at Brock University (905) 688-5550, ext. 4876, lori.walker@brocku.ca. If you have any comments or concerns about your rights as a research participant, you may also contact the Research Ethics Office at (905) 688-5550, ext. 3035, reb@brocku.ca.

If you have any questions, or you would like to volunteer for the study, please contact our research team at **905-688-5550 ext. 6706** or (**jkoudys@brocku.ca**) and state that you're interested in the "SLEEP STUDY." A member of our research team will contact you to answer a few questions and/or set up an appointment.

Thank you for considering this request.

Sincerely,

_____

Dr. Julie Koudys, C.Psych., BCBA-D
Assistant Professor
Department of Applied Disability Studies
Brock University

_____
Angeline Savard, MSc, BCBA, OCT
Principal, Kalyana Support Systems

_____
Catherine McConnell, MEd, RSW, BCBA
Executive Director, Kalyana Support Systems

_____
Krysten Spottiswood, MA, BCBA
Consultant, Pyramid Educational Consultants of Canada

_____
Amanpreet Randhawa, M.ADS
Student Co-Investigator, Brock University

Appendix C

Nighttime Coaching Schedule

DATE INTRODUCED:

NIGHTLY COACHING	
Designated Time Periods	Every evening
Feedback:	Supportive and corrective feedback to parents using VSee instant-messaging feature.
NIGHTLY COACHING FADING SCHEDULE	
Step 1	Observation every night for 4 nights <u>Criteria to move forward:</u> final 2 sessions at 80% or above on treatment fidelity checklist
Step 2	1 night off between 2 consecutive nights of observations <u>Criteria to move forward:</u> Final 2 sessions at 80% or above on treatment fidelity checklist
Step 3	Observation every other night <u>Criteria to move forward:</u> 2 consecutive sessions at 80% or above on treatment fidelity checklist
Step 4	Observation every third night <u>Criteria to move forward:</u> 2 consecutive sessions at 80% or above on treatment fidelity checklist
Step 5	Observation every fourth night <u>Criteria to move forward:</u> 2 consecutive sessions at 80% or above on treatment fidelity checklist
Step 6	Observation every fifth night <u>Criteria to move forward:</u> 2 consecutive sessions at 80% or above on treatment fidelity checklist
Step 7	Observation every seventh night (at least once a week) <u>Criteria to move forward:</u> 2 consecutive sessions at 80% or above on treatment fidelity checklist
DATA COLLECTION	
Revision criteria: 60% or below on treatment fidelity checklist for 1 night at current step - If parent meets revision criteria, observation every night - Criteria to continue at the step that parents were previously on is 80% or above on 2 booster sessions	

Appendix D

Parent Treatment Fidelity Checklist

PARTICIPANT:

Instructions:

1. Observe the parent implementing the bedtime routine to 15 minutes after they bid goodnight
2. Record data for the set up, bid goodnight routine, and response to sleep-interfering behaviours.
3. In the morning, watch the D-Link event recording clips to collect data on the sleep log items, morning routine, and morning D-Link check
4. Scoring conventions:
    - **0 = parent performed incorrectly**
    - **1 = parent performed correctly**
    - **N/A = not applicable**

Date of Observation:	
Data Collector:	
IOA: Y / N	
Date of Scoring:	
Study Phase: Baseline / Intervention / Follow-up	
Item	**Score**
SET UP	
Parent sets up camera	
Child's bed is clear of all items except bedding	
Parent mattress positioned at target distance (if applicable)	
Child is offered opportunities to engage in bedtime routine (as specified in child's intervention plan)	
BID GOODNIGHT ROUTINE	
Parent takes child to bedroom (at designated time specified in child's intervention plan)	
Parent follows sequence: settle child into bed, pull blanket over child, issues bid "goodnight" (kiss optional)	
Parent turns off lights	
Parent records the time child was bid goodnight on the sleep log	
Parent positions themselves in designated location	
Parent avoids attending to child, says "time to sleep/goodnight" no more than approximately once every 5 minutes, if necessary - If child asks a question, parent may respond <u>once</u>	
Parent remains in designated location for target time period	
Parent records the correct time that child fell asleep on the sleep log	
RESPONSE TO SLEEP-INTERFERING BEHAVIOURS	
Parent ignores any sleep-interfering behaviours	
If child gets out of bed, parent places him/her back in bed without saying anything - Parent may state the instruction (e.g., "It's time for bed" once)	
On the sleep log, parent correctly identifies whether there were any sleep-interfering behaviours	
MORNING ROUTINE	
Parent wakes child up (at designated time)	
Parent records time child woke up on sleep log	
Parent uploads sleep log to VSee	
MORNING D-LINK CHECK	
Did parent appear to be sleeping at their target location?	
If the child left the room, did parent return them to bed?	

% OF PARENT TREATMENT FIDELITY	
Total number of 1's scored	
Total number of items (1's + 0's) scored	
% of parent treatment integrity	

Appendix E

Parent Treatment Decisions Checklist

PARTICIPANT _____

Instructions:

1. Once parent uploads the sleep log from the previous night to VSee, check their treatment decisions.
2. Scoring conventions:
    - **0 = parent makes an incorrect decision**
    - **1 = parent makes a correct decision**
    - **N/A = not applicable**

Parent: Treatment Decisions	
Date of Observation:	
Data Collector:	
IOA: Y / N	
Date of Scoring:	
Study Phase: Baseline / Intervention / Follow-up	
Item	**Score**
Parent correctly identifies bedtime for the next night	
Parent correctly identifies whether their position changes	
Parent correctly identifies their position in the room	
Parent correctly identifies whether their child earns their reward	
% OF PARENT TREATMENT DECISIONS	
Total number of 1's scored	
Total number of items (1's + 0's) scored	
% of parent treatment decisions	

Appendix F

Nightly Sleep Log

Date: _____ IOA: Y / N
Data Collector: _____ Date of Scoring: _____

Instructions:

1. At night:
    a. Record the time you bid goodnight to your child
    b. Record the time your child fell asleep
    c. Circle yes or no if your child fell asleep within 20 minutes of the 'bid goodnight'
2. In the morning:
    a. Circle yes or no if your child engaged in sleep-interfering behaviour
    b. Circle yes or no if you were at the target position
    c. Record the time your child woke up
    d. Record whether you had to wake your child up
    e. Based on your child's data and individual program, make 4 treatment decisions for the next night!

INITIALS	BID GOOD NIGHT time	FALL ASLEEP time	Did your child fall asleep within 20 minutes of 'bid goodnight'?	Did your child engage in sleep-interfering behaviour?	Were you at the target position?	MORNING Time awake	Did you wake the child up?
			Yes	Yes	Yes		Yes
			No	No	No		No

TREATMENT DECISIONS:

1) Based on the sleep log and your child's individual program, what time is bedtime tonight? _____
2) Based on the sleep log and your child's individual program, should you move your position tonight? Y / N
3) Based on the sleep log and your child's individual program, what should your position be in the room tonight? _____
4) Based on the sleep log and your child's individual program, did your child earn their reward? Y / N

NOTES:
Please upload your datasheet. Thank you!

Appendix G

Child D-Link Datasheet

Instructions:

1. Watch the clips from the assigned night

2. Record clips from the bedtime routine in the BEDTIME ROUTINE worksheet

3. Record clips from the bid goodnight to morning time awake in the NIGHT worksheet. Follow the instructions on the worksheet for identifying duplicates and changing the FIRST clip that starts after midnight. In this same worksheet, record the time the parent bid goodnight to the child, fall asleep time, and morning time awake.

3a. Watch the clips from the assigned night. Only record clips in which the child is in his/her own bed. If the child was initially in his/her bed but then left, record this clip. If the child does not return within 15 minutes, delete the number in column "L."

For each clip:
i. Determine if movement is related to the participant
ii. Specify whether the child is awake or asleep AND whether he/she engaged in sleep-interfering behaviours according to the definitions. Note: you may record instances in which the child is awake and engaging in sleep-interfering behaviour or instances in which the child is awake and not engaging in sleep-interfering behaviour. If the child is asleep, indicate N/A for sleep-interfering behaviour.
iii. Record any additional notes
3b. Record the fall asleep time:

- Look for the first period of time that is 15 minutes or longer where there are no data clips (this indicates there hasn't been any movement)
- Once you've found a 15-minute gap, go to the clip directly before the first 15-minute period where there's no movement
    - If movement is related to the child: Record the time at the end of the clip. ADD 15 minutes for fall asleep time
    - If movement is not related to the child, look at the clip that comes before. Record the time at the end of the clip. ADD 15 minutes for fall asleep time.
    - If the clip before is the bid goodnight, record the time at the end of that clip. ADD 15 minutes for fall asleep time.

4. Do not record any clips past the parent's indicated morning time awake window. For example, if this window is 7:00 AM – 7:45 AM, then do not record any clips past 7:45 AM. You will still need to record morning time awake if there are clips past this time.

5. Complete the sleep log

PARTICIPANT:
Date of Video: _____
Data Collector: _____
Date of Scoring: _____

Bid goodnight time: _____ Fall asleep time: _____

Sleep onset delay: _____ Morning time awake: _____

Clip Start Time	Clip End Time	Awake or Asleep?	Sleep-Interfering Behaviours?	Notes
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	
		Awake / Asleep	Yes / No / N/A	

Total Sleep Duration: _____

Appendix H

Parent Consent Form

I agree to participate in the Sleep Intervention Study being conducted at Brock University. I understand that the purpose of the study is to find out about the effectiveness of individualized behavioural sleep interventions, aimed at decreasing sleep problems in children with neurodevelopmental disorders. ____

I understand that I will be assigned a Research Team as part of my involvement in the sleep intervention study. I understand that the research team that will be involved in the sleep intervention will include people from Brock University and Kalyana Support Systems, including Dr. Koudys (Brock University), senior staff members at Kalyana Support Systems (Catherine McConnell, Angeline Savard), and trained Research Assistants. ____

If I am currently a client of Kalyana Support Systems, I understand that Dr. Koudys will be a part of this Research Team. I understand that her role on this research team is separate from her role as my child's Clinical Supervisor. I also understand that I will be assigned a Research Coordinator who is a staff member at Kalyana Support Systems, who is not involved in my child's IBI/ABA clinical treatment. ____

I understand that I would be required to meet with a member of the research team and complete a brief information sheet and questionnaire about myself and my child. I understand that this meeting will be conducted virtually and will take approximately 1 to 1 ½ hours. ____

I understand that I am required to meet virtually with researchers to complete a sleep assessment for my child. I understand that as a component of this assessment, I would be required to complete an interview about my child's sleep habits. I understand this meeting will take approximately 1 to 1 ½ hours. I also understand that I will be asked to complete nightly sleep logs as part of this initial assessment. I also understand that as part of the assessment the research team will observe my child's bedtime routine and sleep through a secure videoconference platform. _____

After the assessment, I understand that an individualized sleep intervention will be developed for my child.
I understand that researchers will provide me and/or my spouse with training to learn how to implement the sleep intervention. I understand that my spouse and I will continue to implement the intervention on a nightly basis for the duration of the sleep study. _

As part of the study, I understand that my clinical team and trained research assistants assist me with the intervention and to collect data. I understand that some of my son or daughter's nightly sleep will be videotaped and researchers will collect data related to my child's sleep, and my performance in implementing the intervention, through online observation, and video review. I understand that my team may provide support to me through the use of phone calls and/or video chat technology (e.g., "FaceTime"). I understand that I will also be asked to complete nightly sleep logs. ____

I understand that there are possible risks associated with my and my child's participation in this study, including diminished sleep as our family adjusts to the new routine, a possible increase in my child's problem behaviour (e.g., crying, tantrums, aggression), and stress associated with learning new strategies and receiving in-home support and coaching. _____

I understand that participation is totally voluntary, and I know that it will make no difference to any services my son/daughter or family receives if we participate or not. I understand that there are no known risks to participation. _____

I understand that a component of this study involves me monitoring my child's progress. I understand that this means I will meet with a member of the research team as required (e.g. daily, weekly) to discuss my child's progress. _____

I understand that participation in this study requires access to a computer and a reliable internet connection. ___

I am aware that some of my child's information will be stored on a cloud-based storage system called "Sync," which provides end-to-end encryption, completely safeguarding data from unauthorized access, and allows the research team to ensure data privacy compliance. All other information collected in the study will be stored securely, in a locked cabinet in a locked office at Brock University and will only be accessed by people directly involved in the research under the supervision of Dr. Koudys. Files will be kept for 5 years; following this they will be securely destroyed. In computer data files, I understand my name and my child's name will be replaced with a code. ____

I understand that all information collected will be kept confidential, within the limits of the law. I understand there are rare exceptions involving serious matters such as child abuse, sexual abuse by a health care provider, imminent risk of harm, and legal situations, where confidentiality cannot be guaranteed. ____

I understand that results of this study may be published in professional journals and presented at conferences. All identifying information will be removed, and only pseudonyms will be used to refer to participants. ____

- ☐ I agree to participate in the study which includes a questionnaire, an interview, completion of nightly sleep logs, my participation in training and implementation of the sleep intervention, as well as collection of data related to my child's intervention (and my performance) via online-observation/video review.
- ☐ I have made this decision based on the information I have read in the Information Letter and Consent Form.
- ☐ I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future.
- ☐ I understand that I may withdraw this consent at any time.

Parent Name (print): _____

Signature: _____ **Date:** _____

Researcher who obtained consent: _____

Signature: _____ **Date:** _____

If you have any questions or concerns about this study please feel free to please contact our research team at **905-688-5550 ext. 6706** or by email at jkoudys@brocku.ca, at any time.

Appendix I

Participant Demographic Information

Child Code: _____ Today's Date: _____

Person Completing This Form: ☐ Mother ☐ Father ☐ Other:_____

Please tell us about your child:

☐ Male ☐ Female ☐ Non-binary

Age: _____ Date of Birth: _____

Primary Diagnosis:

_____

Evidence Provided: ☐ Yes ☐ No

Other diagnoses:

_____
_____
_____
_____

☐ Prefer not to disclose

Please tell us about your child's education:

1. Does your child currently attend school? ☐ Yes ☐ No ☐ Prefer not to disclose

If so, what grade is your child in: _____

2. What is your child's CURRENT educational placement(s)? Please check all that apply. Provide a brief description of this placement.

☐ Public/Catholic School: _____
☐ Private School: _____
☐ Home-School:_____
☐ ABA/IBI services:_____
☐ Other:_____
☐ Prefer not to disclose

3. On average, how many DAYS per week does your child attend school? _____
☐ Prefer not to disclose

4. On average, how many HOURS PER DAY does your child attend school? _____
☐ Prefer not to disclose

5. On average, how many DAYS per week does your child attend IBI? _____
☐ Prefer not to disclose

6. On average, how many HOURS PER DAY does your child attend IBI? _____
☐ Prefer not to disclose

7. Does your child receive any additional services? Please check all that apply. Provide a brief description of this placement.
☐ ABA/IBI services: _____
☐ Speech Pathology: _____
☐ Physical Therapy:_____
☐ Occupational Therapy:_____
☐ Other: _____
☐ Prefer not to disclose

9. On average, how many days per hours per week does your child receive of each service?
☐ ABA/IBI services: _____
☐ Speech Pathology: _____
☐ Physical Therapy:_____
☐ Occupational Therapy:_____
☐ Other: _____
☐ Prefer not to disclose

10. Does your child take naps? ☐ Yes ☐ No

If so, please provide details such as number of days per week, length of nap and time nap taken:

_____
_____
_____

Parent Code: _____ Today's Date: _____

Person Completing This Form: ☐ Mother ☐ Father ☐ Other:_____

Please tell us about yourself:

☐ Male ☐ Female ☐ Non-binary

Age: _____

1. **Please tell us your highest level of education completed:**

☐ Less than high school
☐ High school
☐ College
☐ University (Bachelor degree)
☐ University (Master degree)
☐ University (PhD degree)
☐ Other: _____
☐ Prefer not to disclose

2. **Please tell us your CURRENT employment status:**

☐ Full time (30 hours+/week)
☐ Part time (less than 30 hours/week)
☐ Unemployed
☐ Other: _____
☐ Prefer not to disclose

3. **Please tell us your CURRENT personal income:**

☐ $200,000+/year
☐ $150,000 - $199,999/year
☐ $100,000 - $150,000/year
☐ $75,000 - $100,000/year
☐ $50,000 - $74,999/year
☐ $30,000 - $49,999/year
☐ $0- $29,999/year
☐ Prefer not to disclose

4. **Please tell us your CURRENT household income:**

☐ $200,000+/year
☐ $150,000 - $199,999/year
☐ $100,000 - $150,000/year
☐ $75,000 - $100,000/year
☐ $50,000 - $74,999/year
☐ $30,000 - $49,999/year
☐ $0- $29,999/year
☐ Prefer not to disclose

5. **Please tell us how many residents CURRENTLY live in your home:**

☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7
☐ 8+
☐ Prefer not to disclose

6. **Will you have support implementing the sleep intervention?** Yes / NO

If so, who will provide this support?

- Other parent/spouse/partner living in the home: Yes / No
- Other parent living in a different residence: Yes / No
- Other family member or friend (please specify): _____

7. **Do you identify as a visible minority?** Yes / No

If yes, which minority group do you identify with:

☐ Not a visible minority
☐ Arab
☐ Black
☐ Chinese
☐ Filipino
☐ Japanese
☐ Korean
☐ Latin American

☐ South Asian
☐ Southeast Asian
☐ West Asian (e.g. Iranian, Afghan, etc.)
☐ Other
☐ Prefer not to answer

8. **Which ethnic origin best describes you?**

☐ North American/Aboriginal
☐ Canadian/American
☐ European
☐ Caribean
☐ Latin, Central, and South American
☐ African
☐ Asian
☐ Oceania
☐ Prefer not to answer

9. **What is the primary language spoken in the home?** _____

10. **Do you speak any other languages?** Yes / No

If yes, please list: _____

Appendix J

Child Behavioural Sleep Intervention Plan Example

DATE INTRODUCED: **REVISION DATES:**

TARGET BEHAVIOURS	
Operational Definitions	Awake: Any occurrence of sleep-interfering behaviour (see definition) OR the occurrence of eyes open (if eyes are visible), lifting head from pillow, any vocalizations (e.g., humming, babbling, talking), repetitive vocal stereotypy (e.g., giggling, humming, scripting), repetitive motor stereotypy (e.g., head shaking, body rocking), the child's hands actively manipulating or repeatedly flapping any items (e.g., books, video games, toys, papers, socks, pillowcases, or curtains) or **excessive** physical movement such as no contact between back and head to any part of the bed (e.g., sitting up) or stretching/lifting limbs. Exclusions may include movements commonly associated with sleep (e.g., rolling over, shifting body position). Asleep: The child lying on his or her back, stomach, or side, without any signs of being awake (see definition) or covers cover the child's entire body with **minimal** physical movement. Sleep-interfering behaviours: Any occurrence of (a) an <u>obvious</u> audible vocalization coming from the child such as crying, calling out, making requests, or screaming, <u>for greater than 5 seconds</u>, (b) getting out and staying out of bed (child left the bed or was not in bed), (c) standing in bed, (d) engaging in motor stereotypy (e.g., head shaking, body rocking, hand flapping) or the child's hands actively manipulating any items such as books, video games, toys, papers, socks, pillowcases, or curtains, or engaging in vocal stereotypy (e.g., giggling, humming, scripting) <u>for greater than 30 seconds</u>, or (e) any occurrence of self-injurious behaviour. A new occurrence is counted when any of the above behaviours have stopped occurring for 5 seconds.
Goal for the Behaviour Intervention Plan	1. Decreases bid goodnight to asleep interval to 20 minutes 2. Eliminate sleep-interfering behaviours over the night 3. Achieve an age-appropriate amount of sleep each night (approximately 9-11 hours [sleepfoundation.org]) 4. Falls asleep in absence of parent by 8:00-8:30 pm 5. Stays asleep in own bed, in absence of parent
Behaviour Assessment	1. Sleep Assessment and Treatment Tool (Hanley, 2005) - Parents interviewed by BCBA supervisor/Primary investigators 2. D-Link observations for 5 nights

Salient Findings	Sleeping is occurring in the presence of parent(s) lying down only. Child falls asleep between 9:00 pm and 11:30 pm (average is 10pm). Wake up time ranged from 6 am (once) to 10:00 am. Average is 8:00 am. Parent reports that they usually wake her up 43% of the time. Child's average sleep duration is 11 hours, 7.25-11.92 hours, which is in the normal range for her age. Sleep-interfering behaviours include demands for parents to be present, playing with toys, and self-stimulatory laughing.

INTERVENTION PLAN	
Literature/Behaviour Principles	Jin, Hanley & Beaulieu (2013); Hanley (2005)
Designated Time Periods	Every evening
Response to sleep-interfering behaviours during treatment:	Faded bedtime. Extinction not advised. Reduction in quality of reinforcement (i.e., attention through presence but not conversation or interaction).
TREATMENT STEPS	
Step 1	Bedtime based on average fall asleep time during baseline, cleared room, parent participant on mattress on the floor, door closed. 1. "Quieting" routine carried out (toothbrushing, reading of story, decrease ambient lighting) 2. "Bid Goodnight" routine is started at 10 pm (To increase EO for sleep) "Bid Goodnight" routine consists of the following steps: 1. Take child to the bedroom. Don't turn on the light. Parent can say, time for bed, but otherwise keep talking to a minimum. 2. Parent lies down beside child (previous SD to sleep) 3. Say "Goodnight (name)" and give a quick kiss (if she permits) 4. Lie quietly beside child. Do not provide any attention (verbal or otherwise), unless necessary for safety reasons. 5. If child sits or stands up or engages in other disruptive behaviour, say "Time to sleep" no more than once every 5 minutes. Stay lying down and model trying to fall asleep. 6. Remain in bed until child falls asleep. Child earns reward in the morning if she did not engage in sleep-interfering behaviours the previous night. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 2	Same as step 1 but with bid goodnight routine starting at 9:45 pm MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 3	Same as step 2 but with parent sleeping on mattress placed immediately beside the child's bed, door closed.

	MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 4	Same as step 3 but with bid goodnight routine starting at 9:30 pm. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 5	Same as step 4 but with parent sleeping on mattress placed in the middle of the child's room, door closed. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 6	Same as step 5 but with bid goodnight routine starting at 9:15 pm. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 7	Same as step 6 but with parent sleeping on mattress placed in the doorway, in full view of child. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 8	Same as step 7 but with bid goodnight routine starting at 9 pm. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 9	Same as step 8 but with parent sleeping on mattress placed in the doorway, in partial via of child. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 10	Same as step 9 but with bid goodnight routine starting at 8:45 pm. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 11	Same as step 10 but with parent sleeping on mattress placed in hallway outside of child's room, a corner of the mattress in view of the child, door partially closed. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 12	Same as step 11 but with bid goodnight routine starting at 8:30 pm. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 13	Same as step 12 but with parent sleeping on mattress placed in hallway outside of child's room, door closed.

	MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 14	Same as step 13 but with bid goodnight routine starting at 8:15 pm. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Step 15	Same as step 14 but with bid goodnight routine starting at 8 pm. MASTERY CRITERIA: No sleep-interfering behaviours and child falls asleep within 20 minutes over 2 consecutive nights.
Consequence Strategies	Guide child back to bed, without saying anything (do this repeatedly, if necessary). Prevent access to reinforcers (toys, conversation with parents)
DATA COLLECTION	
Collect data on bid goodnight time, fall asleep time, sleep-interfering behaviours, morning wake time, and total sleep duration, as indicated in the child's operational definitions.	
Revision criteria: Target not mastered over 4-day period.	

Appendix K

Parent Handout – How to Complete the Nightly Sleep Log

1. Record the time you **bid goodnight** to your child
    - The time you said goodnight to your child

2. Record the time your child **fell asleep**
    - 15-minutes of no awake OR sleep-interfering behaviours
    - The child lying on his or her back, stomach, or side, without any signs of being awake
    - OR covers cover the child's entire body with minimal physical movement
        - Awake: Any occurrence of sleep-interfering behaviour OR eyes open (if eyes are visible), lifting head from pillow, any vocalizations (e.g., humming, babbling, talking) or repetitive vocal stereotypy (e.g., giggling, humming, scripting), motor stereotypy (head shaking, body rocking, or the child's hands actively manipulating or repeatedly flapping any items such as books, video games, toys, papers, socks, pillowcases, and curtains), excessive physical movement such as no contact between back and head to any part of the bed (e.g., sitting up). Exclusions may include movements commonly associated with sleep (e.g., rolling over, moving legs)

3. Circle yes or no if your child fell asleep within **20 minutes** of the 'bid goodnight'

4. Circle yes or no if your child engaged in **sleep-interfering behaviour**
    - An obvious audible vocalization coming from the child such as crying, calling out, making requests, or screaming, for greater than 5 seconds, getting out and staying out of bed (child left the bed or was not in bed), standing in bed, motor stereotypy (e.g., head shaking, body rocking, hand flapping) or the child's hands actively manipulating any items such as books, video games, toys, papers, socks, pillowcases, or curtains, or engaging in vocal stereotypy (e.g., giggling, humming, scripting) for greater than 30 seconds

5. Circle yes or no if you were at the **target position**
    - According to your child's program

6. Record the **morning time awake**
    - The time your child woke up

7. Record **whether you had to wake your child up**

8. Based on your child's data and individual program, make four **treatment decisions** for the next night!

Appendix L

Parent Handouts – Behaviour-Change Strategies

Tolerating Parent Absence

In order to improve your child's sleep, we want to teach your child to sleep independently. Over the course of the night, without remembering, we wake up multiple times naturally. During this time, we scan the environment and fall back asleep. If your child doesn't fall asleep independently, then it'll be difficult for him to fall asleep independently during these times.

We'll be teaching your child to tolerate your absence using a procedure called 'systematic desensitization,' which involves gradually removing your presence from his bedroom after the "bid goodnight." The first few steps involve you staying with your child at specific locations until he falls asleep, to get him used to you being further away.

Once your child has had a night in which he falls asleep in his bed within 20 minutes of the bid goodnight with no sleep-interfering behaviour, you can move the mattress location to the next step.

Faded Bedtime

Currently, your child is going to bed at 9:45 pm. Your goal is 8:30 - 9 pm. As we work towards your child's desired bedtime, you will begin by putting him to bed at 10:15 pm.

Faded bedtime involves temporarily adjusting your child's bedtime based on his current sleep time. The initial bedtime we set coincides with the time your child fell asleep during the assessment. We want to make sure that the time between when they are put to bed and when he falls asleep remains short. This allows for smooth transitions and may prevent sleep-interfering behaviour. We chose 10:15 pm because it was the most consistent with your child's natural sleep time. Once your child has fallen asleep successfully (with no sleep-interfering behaviour) within 20 minutes of the bid goodnight, you will begin to put your child to bed earlier. You'll keep moving the bedtime up until your child's desired bedtime is reached.

Responding to Sleep-Interfering Behaviour

The next step to improve your child's sleep is to learn why he engages in sleep-interfering behaviour at night and how to respond to those behaviours. From the assessment it appears your child leaves the bedroom, jumps on his bed, and/or engages in motor or vocal stereotypy after you've said goodnight. Your child engages in these behaviours likely because he/she receives your attention, accesses toys, and/or gets to leave the bedroom. This likely results in your child continuing to engage in these sleep-interfering behaviours. But the good news is

that there are strategies that we can use to respond when these behaviours occur and to help reduce their occurrence in the future.

Extinction is a procedure that may decrease the occurrence of sleep-interfering behaviours. The objective is to change the consequences your child receives when he engages in sleep-interfering behaviour. The assessment results suggest your child currently receives your attention, accesses toys, and gets to leave the bedroom. We want to prevent these things from being provided after sleep-interfering behaviour. In the beginning, this can be extremely hard and stressful for both you and your child. You may also see an increase in sleep-interfering behaviour in order to produce those same consequences. The checklist is designed to help you remember how to respond when sleep-interfering behaviours occur at night.

Putting your Child to Bed

The next step to improve your bedtime routines help settle your child into bed each night. The routine provides predictability because the same events are happening consistently before bedtime. As a part of the bedtime routine, we also incorporate a bid goodnight routine. The bid goodnight routine signals to your child that it's time to fall asleep. It sets the stage for you to leave the bedroom and for your child to sleep. Each night, you'll be completing the same bid goodnight routine as part of your child's bedtime routine.

Appendix M

Treatment Acceptability Rating Form – Revised

Please complete the items listed below. The items should be completed by placing a check mark on the line under the question that best indicates how you feel about the BCBA's treatment recommendations.

1. How clear is your understanding of this treatment?

____	____	____	____	____	____
Not at all clear			Neutral		Very clear

2. How acceptable do you find the treatment to be regarding your concerns about your child?

____	____	____	____	____	____
Not at all acceptable			Neutral		Very acceptable

3. How willing are you to carry out this treatment?

____	____	____	____	____	____
Not at all willing			Neutral		Very willing

4. Given your child's sleep difficulties, how reasonable do you find the treatment to be?

____	____	____	____	____	____
Not at all reasonable			Neutral		Very reasonable

5. How costly will it be to carry out this treatment?

____	____	____	____	____	____
Not at all costly			Neutral		Very costly

6. To what extent do you think there might be disadvantages in following this treatment?

____	____	____	____	____	____
Not at all likely			Neutral		Many are likely

7. How likely is this treatment to make permanent improvements in your child's behaviour?

____	____	____	____	____	____
Unlikely			Neutral		Very likely

8. How much time will be needed each day for you to carry out this treatment?

Little time will be needed			Neutral		Much time will be needed

9. How confident are you that the treatment will be effective?

Not at all confident			Neutral		Very confident

10. Compared to other children with sleep difficulties, how serious are your child's problem?

Not at all serious			Neutral		Very serious

11. How disruptive will it be to the family (in general) to carry out this treatment?

Not at all disruptive			Neutral		Very disruptive

12. How effective is this treatment likely to be for your child?

Not at all effective			Neutral		Very effective

13. How affordable is this treatment for your family?

Not at all affordable			Neutral		Very affordable

14. How much do you like the procedures used in the proposed treatment?

Do not like them at all			Neutral		Like them very much

15. How willing will other family members be to help carry out this treatment?

Not at all willing			Neutral		Very willing

16. To what extent are undesirable side-effects likely to result from this treatment?

No side-effects are likely			Neutral		Many side-effects are likely

17. How much discomfort is your child likely to experience during the course of this treatment?

____	____	____	____	____	____
No discomfort at all			Neutral		Very much discomfort

18. How severe are your child's sleep difficulties?

____	____	____	____	____	____
Not at all severe			Neutral		Very severe

19. How willing would you be to change your family routine to carry out this treatment?

____	____	____	____	____	____
Not at all willing			Neutral		Very willing

20. How well will carrying out this treatment fit into the family routine?

____	____	____	____	____	____
Not at all well			Neutral		Very well

21. To what degree are your child's sleep difficulties of concern to you?

____	____	____	____	____	____
Not concern at all			Neutral		Great concern

22. We would value any additional feedback you have for us:

a) What was most helpful?

_____

_____

b) What was least helpful?

_____

_____

c) Recommendations for improvements?

_____

_____

23. Please share anything else you would like us to know about your child and/or family's progress:

_____

Appendix N

Data Collection Training Procedural Integrity Checklist

Sleep coach:	Session Date:	Primary Coder Initials:
Please indicate yes, no, or N/A for the following steps		**NOTES**
A. Review of steps to complete sleep log and operational definitions		
1. Sleep coach reviews rationale		
2. Sleep coach reviews each step		
3. Sleep coach verbally reviews definition		
4. Sleep coach asks the parent if he/she has any questions and clarifies if so		
5. Sleep coach describes examples/non-examples and shows videos (if applicable)		
6. Sleep coach asks the parent if he/she has any questions and clarifies/replays the video if necessary		
7. Sleep coach informs the parent that it's time to practice and ensures the parent has the required materials (e.g., nightly sleep logs, pen, timer)		
Total		
B. Practice & Performance Feedback (2 trials during training)		
1. Sleep coach plays the videos		
2. Sleep coach instructs the parent to show **OR** tell how he/she would record data		
3. Sleep coach provides praise for correct actions		
4. Sleep coach provides corrective feedback as required		
5. If corrective feedback was given, the sleep coach confirms parent understanding, asks if the parents have further questions, require further clarification		
6. Sleep coach conducts 1-2 practice trial(s) with parent		
7. Sleep coach records data on parent performance		
Total		
Percent Correct Procedural Integrity (Total +'s A & B / total steps A & B X 100)		

Appendix O

Intervention Training Procedural Integrity Checklist

Sleep coach:	Session Date:			Primary Coder Initials:	
Please indicate +, -, or N/A for the following steps within each trial	**1 Set-Up**	**2 Bid Goodnight**	**3 Response to SLIB**	**4 Morning Routine**	**NOTES**
A. Written Instructions & Video Model of Treatment Fidelity Checklist					
1. Sleep coach ensures parent has written instructions and treatment fidelity checklist					
2. Sleep coach introduces the section of the TIC					
3. Sleep coach verbally reviews the instruction and checklist					
4. Sleep coach shows the overview video					
5. Sleep coach asks the parent if he/she has any questions and provides clarification as needed					
6. Sleep coach informs the parent that it's time to practice and ensures the parent has the required materials					
Total +'s					
B. Practice & Performance Feedback (1-2 trials during training)					
7. Sleep coach reads the scenario					
8. Sleep coach instructs the parent to show **OR** tell how he/she would complete the steps					
9. Sleep coach provides praise for correct actions					
10. Sleep coach provides corrective feedback as required					
11. If corrective feedback was given, the sleep					

coach confirms parent understanding, asks if the parents have further questions, require further clarification					
12. Sleep coach conducts 2-3 practice trial(s) with parent					
13. Sleep coach records data on parent performance					
Total +'s					
C. Final Practice (3 trials)					
14. Sleep coach reads the scenario					
15. Sleep coach instructs the parent to show **OR** tell how he/she would complete the steps					
16. Sleep coach provides praise for correct actions					
17. Sleep coach provides corrective feedback as required					
18. If corrective feedback was given, the sleep coach confirms parent understanding, asks if the parents have further questions, require further clarification					
19. Sleep coach records data on parent performance					
Total +'s					
Percent Correct Procedural Integrity (Total +'s A & B & C / total steps A & B & C X 100)					

Appendix P

Treatment Decisions Training Procedural Integrity Checklist

Sleep coach:	Session Date:					Primary Coder Initials:
Please indicate +, -, or N/A for the following steps within each trial	**1**	**2**	**3**	**4**	**5**	**NOTES**
Practice & Performance Feedback (3-5 trials during training)						
1. Sleep coach provides sleep log						
2. Sleep coach instructs the parent to complete the treatment decisions section of the sleep log						
3. Sleep coach provides praise for correct actions						
4. Sleep coach provides corrective feedback as required						
5. If corrective feedback was given, the sleep coach confirms parent understanding, asks if the parents have further questions, require further clarification						
6. Sleep coach records data on parent performance						
Total +'s						
Percent Correct Procedural Integrity (Total +'s / total steps X 100)						

Appendix Q

Nighttime Coaching Procedural Integrity Checklist

Sleep coach:	Date:	Primary Coder Initials:
Performance Feedback		NOTES
1. Sleep coach sends a text to the parent(s), notifying them that he/she is observing		
2. Sleep coach provides praise for correct actions		
3. Sleep coach provides corrective feedback as required		
4. Sleep coach records data on parent performance		
5. Sleep coach sends a text to the parent(s), notifying them that he/she is done observing		
Total		
Percent Correct Procedural Integrity (Total +'s / total steps x 100)		