Assessment and Treatment of Sleep Problems in Young Children:

Designing Individualized, Function-based, and Consumer Friendly Interventions Through the Lens of a Contingency

Sandy Jin Ph.D. BCBA-D
California State University, Northridge
chunying.jin@csun.edu

Special Thanks to Gregory P. Hanley Ph.D. BCBA-D
Parents and Caregivers

Behavior Analysts

Pediatricians

Child Psychologists
Prevalent

up to 50% TD

up to 73% ASD

Polimeni et al. (2005)

Persistent

(Kataria et al., 1987; Zuckerman et al., 1987)
Negative Impact on Children

- **Unintentional injuries** (Koulouglioti et al., 2008)
- **Difficult temperament** (Richman, 1981)
- **Obesity** (Bell & Zimmerman, 2010; Magee & Hale, 2012)
- **Poor academic performance** (Dewald et al., 2010)
- **Problem behaviors: noncompliance, aggression, & self-injury** (Wiggs & Stores; 1996)
Negative Impact on Family

- Poor sleep quality (Meltzer & Mindell, 2007)
- Poor daytime functioning (Meltzer & Mindell, 2007)
- Maternal depression (Richman, 1981)
- Marital discord (Chavin & Tinson, 1980)
When Seeking Treatment Options...

On their own

Pediatricians

- 25% rated themselves as confident in treating sleep problems

(Owens, 2001)
Mainstream Treatment Recommendation

Pharmacological and/or Behavioral Interventions
• Antihistamines, Melatonin, Clonidine, Trazodone etc…
• \(\sim 81\%\) of children’s visits result in medication (Stojanovski, et al. 2007)
  • No prescribing guidelines
  • No drug approved by FDA
  • Limited research on efficacy, tolerability and acceptability

• \(\sim 75\%\) of primary care pediatricians reported recommending nonprescription medication
• \(\sim 50\%\) reported prescribing sleep medication (Owens et al. 2013)
Melatonin

- Endogenous hormone secreted by the pineal gland (release suppressed by light)
- Nocturnal peak makes it a synchronizer of circadian rhythm
- Some evidence suggesting that it yields statistically significant improvement in sleep onset delay with minimal side effect
<table>
<thead>
<tr>
<th>Time</th>
<th>Baseline</th>
<th>Behavioral Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:00 pm</td>
<td></td>
<td>Melatonin: 3 mg</td>
</tr>
<tr>
<td>09:00 pm</td>
<td></td>
<td>Clonidine: 0.1 mg</td>
</tr>
<tr>
<td>11:00 pm</td>
<td></td>
<td>Hydroxyzine: 4 ml</td>
</tr>
<tr>
<td>01:00 am</td>
<td></td>
<td></td>
</tr>
<tr>
<td>03:00 am</td>
<td></td>
<td></td>
</tr>
<tr>
<td>05:00 am</td>
<td></td>
<td></td>
</tr>
<tr>
<td>07:00 am</td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:00 am</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:00 am</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Goal bid
goodnight time (09:00 pm)

Goal wake time (08:00 am)

Nights
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Time
Ideal sleep zone
Asleep
Nap

Alice
Mainstream Behavioral Interventions

Recommended 22% of time (Stojanovski et al., 2007)

- More modification than ANALYSIS
- Antecedent-oriented strategies (e.g., positive routine)
- Strategies associated with low treatment acceptability or very few alternatives
- Not personalized or function-based
Assumptions of Behavior Analysis

Autism is NOT a life sentence of poor sleep and tired days
Assumptions of Behavior Analysis

• Falling asleep is a **behavior / skill** (Bootzin, 1972).

• Influenced by
  – Evolutionary history (selection at the level of **phylogenesis**)
  – Past and present experiences in one’s sleeping environment (selection at the level of **ontogeny**)
  – Cultural practice (selection at the level of **culture**)


Assumptions of Behavior Analysis

• Sleep problems are **skill deficits**

• Can be addressed by **understanding** the controlling variables and **teaching** the relevant skills
Lens of **Contingency**

?  Behavior  ?

?
Through the Lens of a Contingency
Today

• What are the common sleep problems?

• What are the common factors that influence good sleep and sleep problems?

• How do we design personalized, function-based, and consumer friendly interventions?
Commonly Reported Sleep Problems

• Bedtime routine noncompliance

• Sleep interfering behavior (e.g., crying, calling out, getting out of bed, aggression, playing etc…)

• Delayed sleep onset

• Night awakenings

• Early awakenings

• Phase shift

• Insufficient sleep
Good Sleep

• Falling asleep quickly
• Staying asleep throughout the night
• Obtaining a developmentally appropriate amount of sleep
• Waking without much trouble
• Not feeling drowsy during the day
Develop Reasonable Sleep Goals

- Falling asleep within minutes (e.g., 5-15 min)
- Staying asleep throughout the night or fall back asleep within minutes
- “Independent” sleep
  - Not relying on your presence
  - Not relying on medication
- Developmentally-appropriate amount of sleep
- Waking without much trouble and not feeling excessive drowsy during the day
Antecedents (what motivates or demotivates?)

Falling Asleep $\rightarrow$ MO $\rightarrow$ SD $\rightarrow$ SR$^+$

Sleep Interfering Behavior $\rightarrow$ MO $\rightarrow$ SD $\rightarrow$ SR$^+$
Develop Optimal Schedule By:

A. Recognize age-appropriate sleep amounts

B. Importance of current sleep phase and “forbidden zone”

C. Universal tendency of to go bed later and wake up later
Schedule a Developmentally Appropriate Amount of Sleep

[Image of a chart showing sleep duration recommendations for different age groups, ranging from newborns to older adults. The chart includes bars indicating the recommended and may be appropriate sleep durations.]
Caution:

Difficulty falling asleep, staying asleep, or complying with nighttime routines may occur if child is expected to be in bed too long.

Difficulty waking up or day time tiredness may be related to child being in bed for too short of a time.

Solution:

Schedule a developmentally-appropriate amount of sleep.
Sleep Phase

Adapted from: *Solve Your Child's Sleep Problems*, Richard Ferber, Simon & Schuster, 2006
Forbidden Zone of Sleep

Midday Dip in Alertness
(okay to nap for a brief period of time (e.g., 20 min)

Alert

Sleepy

Night  Day  Night

Forbidden Zone

Adapted from: Solve Your Child's Sleep Problems, Richard Ferber, Simon & Schuster, 2006
Circadian Rhythm

We have a tendency to go to bed later and wake up later because of our 24.2 hr clock.

Artificial light and nighttime activity availability leads to a 25-hour clock.
Caution:
Putting children to bed during the Forbidden Zone will increase the likelihood of delayed sleep onset, sleep interfering behavior, and routine noncompliance.

Solution:
Faded bedtime (response cost may not be necessary)

At the beginning of sleep treatment:
set the start of the sleep routine slightly later than when the child fell asleep the previous night
Then gradually transition sleep phase earlier
if child falls asleep within 15 min, move bedtime 15-30 min earlier next night until desired bedtime is achieved (Piazza et al., 1991)
Extreme Sleep Phase Shift?

Try *chronotherapy* if sleep phase is more than 4 hours past desirable sleep time:

Move sleep and awake times *forward* by 1 to 2 hours each night (larger leaps can be made with older children)
Antecedents (signal/cue?)

Falling Asleep $S^D$ $S^{R+}$

Sleep Interfering Behavior $S^{R+}$ $S^D$
A. Sleep Dependencies

Transition to sleep depends on stimuli associated with falling asleep
These stimuli must be present throughout the night because children wake up multiple times.
Caution:

Things that occasion sleep are suddenly removed, inconsistently available, or not present when the child wakes up during the night = Sleep Onset Delay, Night Awakenings, and possibly Sleep Interfering Behavior

*Examples*: TV, electronics, radio, books, bottles, “full belly,” presence of another person, being rocked or patted, lights, fallen stuffed animal or blanket
Solution:
Eliminate or fade “bad” sleep dependencies and occasion sleep with things that don’t require your presence, can be there in the middle of the night, and are transportable (e.g., for vacations or nights at Grandparent’s home)

Examples: preferred blanket, stuffed animal, white-noise sound machine on continuously
B. Routinize Nighttime Routine

- Develop a nighttime routine that occasions “behavioral quietude”
- Routine consistently across nights
- Activities progress from active to passive
  - Consider providing choices (e.g., on a picture schedule)
  - Gradual transition from rich to barren environment
- Exercise and baths earlier in the routine
- Progressively dimming ambient light
- Light snacks without caffeine given earlier in the routine and before brushing teeth
Nighttime Routine Noncompliance

Tendency to not follow instructions during bedtime (e.g., brush teeth, put on PJs etc…)

Solution:

– Promote instruction following during the day (different workshop)
  • First consider proactive strategies (form of instruction, reinforce responding to name etc..), then consider reactive strategies (three-step etc…)

– Make sure sleep is valuable (e.g., child is sleepy) when starting routine. Start just prior to “natural” sleep phase

– Discrepancy in consequences for compliance vs noncompliance
  • Avoid TEACHING instruction-following at bedtime
  • Avoid reactive strategies at bedtime (extinction or punishment)
  • Differentially reinforce
# Teaching Responding to Name

Beaulieu et al. (2013 *JABA*)

<table>
<thead>
<tr>
<th>BL1</th>
<th>BL2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M % Compliance</strong></td>
<td><strong>M % Precursors</strong></td>
</tr>
<tr>
<td>$U = 11$, $p &gt; .05$</td>
<td>$U = 12$, $p &gt; .05$</td>
</tr>
<tr>
<td>$U = 4.5$, $p &lt; .05$</td>
<td>$U = 0$, $p &lt; .05$</td>
</tr>
</tbody>
</table>

- **Control** | **Experimental**
- **Individual Children**

[Graphs showing data comparison]
C. Optimize Bedroom Environment

• Bed with comfortable mattress

• Cool temperature
  – Can the child control the temperature?

• Indirect nightlight, curtains closed

• Non-undulating noise

(note these conditions increase the likelihood of healthy sleep dependencies)
Consequences (Reinforcers?)

Falling Asleep $\rightarrow$ MO $\leftarrow$ SR$^+$

Sleep Interfering Behavior $\rightarrow$ MO $\leftarrow$ SR$^+$
Interfering Behavior

– Leaving bed (curtain calls)
– Crying/calling out/excessive requests
– Talking to oneself
– Playing in bed with toys, iPads, etc…
– Motor or vocal stereotypy
– Severe problem behavior (SIB, property destruction)
Possible Reinforcers

• Attention/interaction
• Food/drink
• Access to toys, TV, electronics etc…
• Escape/avoidance of the dark
• Automatic reinforcers directly produced by the behavior
  – Sensory consequences
• Combination

How to Disrupt the Contingency?
• Abolish the value of the reinforcer for SLIB
• Consider provide the presumed reinforcer prior to bidding goodnight
  – Access to stereotypy
  – Access to interaction/attention
• Eliminate stimuli that occasion SLIB
• Consider bidding the “toys, iPads, books” goodnight routine
• Eliminate the presence of preferred activities
• Eliminate the sight of food/drinks/snacks
• Eliminate the signals of interaction/attention
• Withhold access to the presumed reinforcer following SLIB (Disrupt the contingency)
  – “complete” withholding from the start (extinction)
  – Gradual elimination (thinning the reinforcer)
  – Deliver reinforcer independent of SLIB (NCR)
  – Reinforce alternatives, incompatibles, or the absence of SLIB (DRA, DRI, DRO)
EXTINCTION: withholding reinforcer following EACH occurrence of SLIB

– Extinction is procedurally different for attention-, escape-, automatic-maintained SLIB (letting the child cry it out is extinction for only attention-maintained SLIB)
– Rapid reduction of SLIB when consistently implemented

CAUTION:
– Poor treatment compliance may exacerbate the problem
– Extinction procedure does not match the function

Solution:
– Adequate training before implementation
– Frequent support and feedback
– Functional assessment before implementation
– Consider alternatives
Gradual elimination

– reducing the magnitude/intensity of the reinforcer
e.g., QUALITY FADING: gradually reduce the quality of interaction for att-SLIB

– Progressively increase the time from SLIB to the reinforcer
e.g., PROGRESSIVE WAITING (Ferber method)
(risk of exacerbating SLIB)
Deliver the reinforcer independent of SLIB (NCR)

**TIME-BASED VISITING** for att-SLIB (also consider time-based exiting)

Visit your child at increasingly larger intervals after the bid good night and across nights (hopefully before IB occurs); during visit re-tuck them, bid good night, and leave

<table>
<thead>
<tr>
<th>Day</th>
<th>First visit</th>
<th>Second visit</th>
<th>Third visit</th>
<th>Fourth visit</th>
<th>Fifth visit</th>
<th>Sixth visit</th>
<th>Seventh visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 s</td>
<td>30 s</td>
<td>1 min</td>
<td>3 min</td>
<td>5 min</td>
<td>10 min</td>
<td>30 min</td>
</tr>
<tr>
<td>2</td>
<td>30 s</td>
<td>1 min</td>
<td>3 min</td>
<td>5 min</td>
<td>10 min</td>
<td>30 min</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>30 s</td>
<td>3 min</td>
<td>5 min</td>
<td>10 min</td>
<td>30 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1 min</td>
<td>3 min</td>
<td>5 min</td>
<td>10 min</td>
<td>30 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1 min</td>
<td>5 min</td>
<td>10 min</td>
<td>30 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>5 min</td>
<td>10 min</td>
<td>30 min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>5 min</td>
<td>30 min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Differential Reinforcement

QUIET-BASED VISITING
Visit after increasingly larger intervals of quiet

BEDTIME PASS
Give your child one or more bedtime pass(es) to be used as needed after the bidding good night to exchange for reinforcers (e.g., grant request).
• Ideal component?
  – EXT
  – NCR
  – DRA

• Consumer preference?
Just prior to bed, the children were allowed to choose the treatment for each night.

- **Bedtime pass**: Reinforcement only if handed a pass.
- **Extinction**: No reinforcement (period).
- **Time-based Visiting**: Reinforcement available according to time.

**Treatment-Correlated Stimuli**:
- **Blue Card**
- **Green Card**
- **Red Card**
<table>
<thead>
<tr>
<th>Ranking</th>
<th>Sam</th>
<th>Alice</th>
<th>Gina</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mom</td>
<td>Dad</td>
<td>Mom</td>
</tr>
<tr>
<td>1</td>
<td><strong>Time-based Visiting</strong></td>
<td><strong>Bedtime Pass</strong></td>
<td><strong>Extinction</strong></td>
</tr>
<tr>
<td>2</td>
<td><strong>Bedtime Pass</strong></td>
<td><strong>Extinction</strong></td>
<td><strong>Bedtime Pass</strong></td>
</tr>
<tr>
<td>3</td>
<td><strong>Extinction</strong></td>
<td><strong>Time-based Visiting</strong></td>
<td><strong>Time-based Visiting</strong></td>
</tr>
</tbody>
</table>

*Note. 1 = most preferred strategy.*
Assess, Assess, Assess

• SATT (Hanley, 2009)
• rule out medical conditions (e.g., sleep apnea, narcolepsy etc…)

Baseline measurement
• socially acceptable and objective measurement system

Functional behavior assessment (SATT, Hanley 2009)
• identify sleep problems and controlling variables

Design personalized and comprehensive intervention
• encourage parents to develop goals and interventions with clinicians

Parent training
• behavior skills training: instruction, modeling, role-play, and feedback

Treatment implementation with measurement
• support, frequent feedback, reinforce treatment compliance

Social validity
• efficacy AND effectiveness

Follow-up
Summary

• Function-based treatment approach could be both efficacious and socially acceptable
  – Identify controlling variables prior to designing intervention
  – Encourage parents to participate in the design of intervention
Establish the value of sleep around the time a child is bid goodnight (e.g., bedtime fading, chronotherapy)

Falling Asleep

Occasion behavioral quietude with reliable and salient stimuli at bedtime (e.g., white-noise sound machine on through the night, preferred blanket)
Abolish the value of the reinforcer for SLIB prior to and following the bid goodnight (e.g., story time with parents, provide access to stereotypy)

Sleep Interfering Behavior (SLIB)

Eliminate discriminative stimuli for SLIB at bedtime (e.g., setting clear barriers to toys.)

Disrupt the contingency between SLIB and its reinforcer (e.g., extinction, bedtime pass, time-based visiting, quiet-based visiting)
Considerations

– Small sample size
  • (need more direct and systematic replications)
– Data collection effortful
  • Directly observing both child and caregiver behavior
– Parent training costly
Future Areas of Research

• Conditions under which pharmacological interventions are needed
• Better parent training tactics
  – Contingency analysis of parents
• Identify boundary conditions
• More studies targeting both efficacy AND effectiveness
Thank you!

• chunying.jin@csun.edu
• jin.chunying@icloud.com