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Stimulus Control in Cognitive Behavior Therapy for Insomnia (CBT-I): Does it make Sense to Leave the Bedroom during the Night if Sleep is Delayed?

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Abstract

This article puts forth the argument that there is little empirical or theoretical evidence to support a key strategy in stimulus control interventions, as currently used in CBT-I: namely, leaving the bedroom if sleep onset latency (SOL) is longer than 10 to 30 minutes or waking after sleep onset (WASO) exceeds 10 minutes. Although the stimulus control package of interventions is one of the most effective components of CBT-I, evidence is presented that on a conceptual and practical level, the leave-the-room component may increase non-compliance. Alternative strategies are presented as well as a call for more randomized control strategies (RCT) of the efficacy and effectiveness of the various component techniques which are subsumed under CBT-I.

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What is Stimulus Control and What is so Complicated about Applying this Principle to Insomnia?

One of the basic tenants of CBT-I is "stimulus control". Stimulus control, in learning theory, refers to the ability of any stimuli to increase the probability of a specific behavior (operant response) because of a repeated history of that behavior being differentially reinforced in the presence of the specific stimulus. In other words, we learn to discriminate which stimuli are associated with reinforcing or desired behaviors and which stimuli are associated with punishing or neutral behaviors. Our behavior is then shaped by these stimuli. Where there is a simple conditioning history, and one stimulus is always paired with one response, there is a high probability that when you are exposed to that stimulus you will emit only that one response. People adapt to routines and reliable, clear stimuli can predictably elicit very specific responses. We are creatures of habit.

Stimulus control, as applied in CBT-I, tries to restrict the cues surrounding bedtime, the bedroom and the bed to eliciting the sleep response and only the sleep response. The problem is that sleep cues do not involve a simple conditioning history, but involve a very complex conditioning history. The cues for sleep are external and internal; interpersonal and environmental; biological, physiological, emotional and cognitive; developmentally changing and seasonally affected.

For example, the cues for sex are inextricably bound for most people, with many essential sleep cues. When we tell patients to use the bed "only for sleep and sex" it is like telling them "only use the bed to get aroused and to relax". While sleep doctors have totally overlooked or denied the contribution of sexual frustration and dysfunction to possible insomnia maintenance, there are other inevitable and contradictory cues associated with the bed. Equally important, the bed is the only place that many people can have privacy – to think their own thoughts for more than 10 seconds and/or to have intimate or needed debriefing conversations with

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their partner. It is a refuge from the demands of the external world and these cues we would want to strengthen in an effort to help the insomniac lower their arousal levels. For the many insomniacs who ruminate or worry in bed, though, it may be more important to learn to think about their problems differently than to change the place where their thoughts torment them. In addition, to get up in the middle of the night and stay in the living room with piles of laundry on the floor and unpaid bills are the table might offer many anti-sleep cues – even in the dark.

The following brief review of the LTB technique will hopefully heighten awareness of the pros and cons of this dramatic intervention, stir clinicians to innovate, and motivate researchers to testing more complex and varied stimulus control strategies.

How is Stimulus Control Operationalized in CBT-I ?

Stimulus control, as currently used in CBT-I, is focused on re-conditioning the external cues for sleep onset and sleep maintenance. The three main external cues associated with sleep are bedtime, the bed, and the bedroom. To this end, the original stimulus control (SC) technique developed by Bootzin (1972, 1973) [1,2] consisted of advising the patient to

a. Lie down in bed only when sleepy

b. Use the bedroom only for sex and sleep

c. Do not take naps

d. Get up out of bed as at the same time each day and

e. Get out of bed and leave the bedroom if the sleep onset latency (SOL) or time awake after sleep onset (WASO) lasts between 10 and 20 minutes (Bootzin advised 10 minutes). Subsequent adaptations have recommended that if the sleep onset latency (SOL) is more than 30 minutes, go to another dimly lit room and stay there till sleepy [3]. Most practitioners employ the 30 minute recommendation.

The most detailed reports of stimulus control interventions include procedures like those reported by Vincent et.al. (2008) [4], "To address stimulus control (SC), participants were asked to remove themselves from bed at night if unable to sleep after approximately 20 minutes. During the group sessions, we problem-solved the types of activities that participants might engage in and had them prepare a place to go to should they awaken during the night. They were told that they should return to bed immediately upon feeling sleepy"(p. 823).

Empirical, Theoretical, and Clinical Problems with Leaving the Bedroom (LTB) Prescriptions

There is a lack of empirical data indicating which components of stimulus control are either sufficient or necessary for changes in insomnia

There are a plethora of studies that attest to CBT-I's effectiveness but fewer that have looked systematically at which components of CBT-I are necessary, which sufficient, and which are superfluous. Most studies that have examined stimulus control have done so as part of a CBT-I package that includes sleep restriction (Sleep restriction is the second major component of CBT-I and involves having the client reduce their sleep expectation and total sleep time to the number of hours they are actually sleeping with the insomnia. Thus, if someone is only getting five hours of sleep a night and they need to get up at 7 am, they are told to refrain from getting into bed until 2 am. Once quick and sustained sleep is achieved on this schedule, an earlier time to bed is slowly restored, in 15 minute increments, until a full night's sleep can be achieved. So after going to sleep quickly at 2 am for a few days, the bedtime is shifted to 1:45 am for a few days, and if successful this shifts to 1:30 am, etc.) These two procedures (sleep restriction and stimulus control) are routinely packaged and assessed together as a unit. Within stimulus control strategies, all the research to date, has assessed the package of 6 techniques/strategies as described by Bootzin (1972) [1] and expanded by others.

A few studies have examined stimulus control, as a package of techniques, independent of sleep restriction, in the treatment of insomnia. The reviews of those studies have given independent verification that, *as a package of techniques*, stimulus control does have a positive effect on insomnia, and in fact, is one of the most effective, if not the most effective single component of sleep therapy [5,6,7,8]. For example, Morin and Azrin (1987) [9] found that a group of stimulus control strategies, including "controlling sleep incompatible behaviors and regulating the wake-sleep schedule" was superior to imagery training in reducing sleep-maintenance insomnia in 21 patients, reducing their wake time after sleep onset by 65%. Puder et.al. (1982) [10] assessed the effectiveness of multi-strategy stimulus control procedures in 16 older adults with sleep onset insomnia. The stimulus control procedures involved not using the bedroom for reasons other than sleeping, getting out of bed upon awakening and getting up when unable to fall asleep or not get back to sleep. Results showed a strong treatment effect that was maintained at 8 weeks.

Yet, more nuanced studies testing the effectiveness of stimulus control have questioned its importance and theoretical rationale. A very important study by Zwart and Lisman (1978) [11] specifically assessed the effects of stimulus control and found that both stimulus control and a treatment that specifically violated the associative aspect of stimulus control produced equal improvements in sleep onset; both of which were significantly better than the waiting list control. Although this is one of the earliest CBT-I studies, its results need to be studied by current day practitioners. The study had five different groups 1) a stimulus control procedure as outlined

by Bootzin (see above); 2) a noncontigent control where each participant was yoked to someone in Group 1 and had to wake up a specified number of times (depending on how many times their yoked control woke up in Group 1), 3)a counter-control group where participants, if unable to fall asleep within 10 minutes of retiring were to remain in bed, sit up, and engage in some activity, 4) a temporal control group where subjects were told to lie down only when sleepy, not take any naps, and wake up at the same time each day. They were not given any instructions to leave the bed and 5) a waiting list control. Each group met once weekly for 30 minutes for four weeks beyond the baseline. At the end of treatment, all treated groups showed similar improvements over the waiting list group. At a 4 week follow -up, both the stimulus group (Bootzin's procedures) and the counter-control group (just stay in bed and read) reported maintaining or enhancing their gains. What does this mean? The one study that examined in bed distracters and in bed relaxers found it was as effective as LTB prescriptions [11].

Perlis et. al. (2005) [3] has suggested that the prescription to leave the bedroom works because the treatment is based on instrumental conditioning principles. "The patient engages in a voluntary behavior (get up and leave the bedroom) and this is likely maintained by a variety of reinforcers, including when the patient returns to bed and falls asleep quickly"(p. 14). Indeed, given the results of Zwart and Lisman (1979) [11], an alternative hypothesis for the successful use of this intervention is that telling patients to get up and leave the bedroom heightens their arousal and provides a punishment for night arousal. The change in sleep onset operates via "negative reinforcement" – meaning if the patient sleeps through the night, they won't be punished by having to go to another room for "time out". Let's look at the actual data: Zwart and Lisman found that individuals who received a stimulus control treatment decreased their sleep onset time by 20.96 minutes (baseline M=46.12; SD=20.82; follow up M=25.16, SD=10.28) while the counter-control treatment group, told if unable to fall asleep within 10 minutes to remain in bed, sit up, and engage in some activity (e.g. reading) until sleepy, decreased their sleep onset time by 30.64 minutes (baseline M=49.11; SD=29.42; follow up M=18.42, SD=5.28). This was a non significant difference between the two treatments, but both were statistically better than the waiting list control group's decrease of 4.43 minutes (baseline M=46.00, SD=18.97; follow up M=41.57, SD=16.40) .

The lack of any data about the distinct impact of the LTB directive strengthens the argument that we may be creating a myth about the importance of this procedure.

There are other studies challenging the theoretical rationale of stimulus control, such as the ones done by Turner and Ascher (1972a. 1972b) [12,13] who found that progressive relaxation and paradoxical interventions (where they were told to try to stay awake without moving). Turner and Ascher found that individuals who received a stimulus control treatment decreased their sleep onset time by 42.70 minutes (pretreatment M=64.20; SD=36.43; post treatment M=21.50, SD=11.64) while the paradoxical treatment group, told to try to stay awake and not move in bed decreased their sleep onset time by 33.30 minutes (pretreatment M=62.50; SD=31.58; post treatment M=29.20, SD=15.04). This was a non significant difference between the two treatments, but both were statistically better than the waiting list control group's decrease of 10.10 minutes (M=69.90, SD=19.01; post treatment M=59.80, SD=22.95) . Both Turner and Ascher (1972) [12,13] and Zwart and Lisman (1979) [11] report stimulus control interventions and anti-stimulus control interventions can decrease sleep onset between 20 and 30 minutes. This provides evidence that the type of stimulus control described by Bootzin (1972) [1] may be sufficient but is not necessary. Although current research has not been directed towards exploring these anomalies, with increasing application of CBT-I procedures, both expanded theoretical models and research are needed.

Lack of Theoretical Evidence to Suggest that LTB upon Awakening is a form of Stimulus Control

The arguments put forth in this paper are an application of stimulus control topography theory (SCT) [14]. SCT is centered on discerning the qualitative differences among members of a functional stimulus class. It was developed to better explain perceived stimulus equivalences as well as individual differences in stimulus generalization and discrimination. That is, SCT is a paradigm shifter that stresses that external stimuli are not eliciting stimuli just because they are defined so by the researcher - rather they are perceived and defined by the eye of the beholder. Attentional processes, motivational processes, and developmental processes effect what characteristics of a "stimuli" are actually controlling a "response".

CBT-I postulates that "the bedroom" is the stimulus that needs to be paired with the sleep response. SCT, which comes from broader learning theory, reminds us that the bedroom contains a limitless number of stimuli, any one of which may be eliciting the sleep or wake response, and it is the job of the clinician to work with each client to understand what are controlling stimuli for sleep and wakefulness in the bedroom as well as in other rooms of the house. While LTB may work for many individuals, for many others a more nuanced analysis of sleep and wake stimuli should lead to improved outcomes. Figure 1 compares the CBT-I model of controlling sleep/wake stimuli with the SCT model of potential controlling stimuli for sleep onset. The SCT model does not negate any of the CBT-I model but simply expands it in a way that may help explain why CBT-I sometimes fails.

Clinically, we need to ask what are the likely sleep-onset and

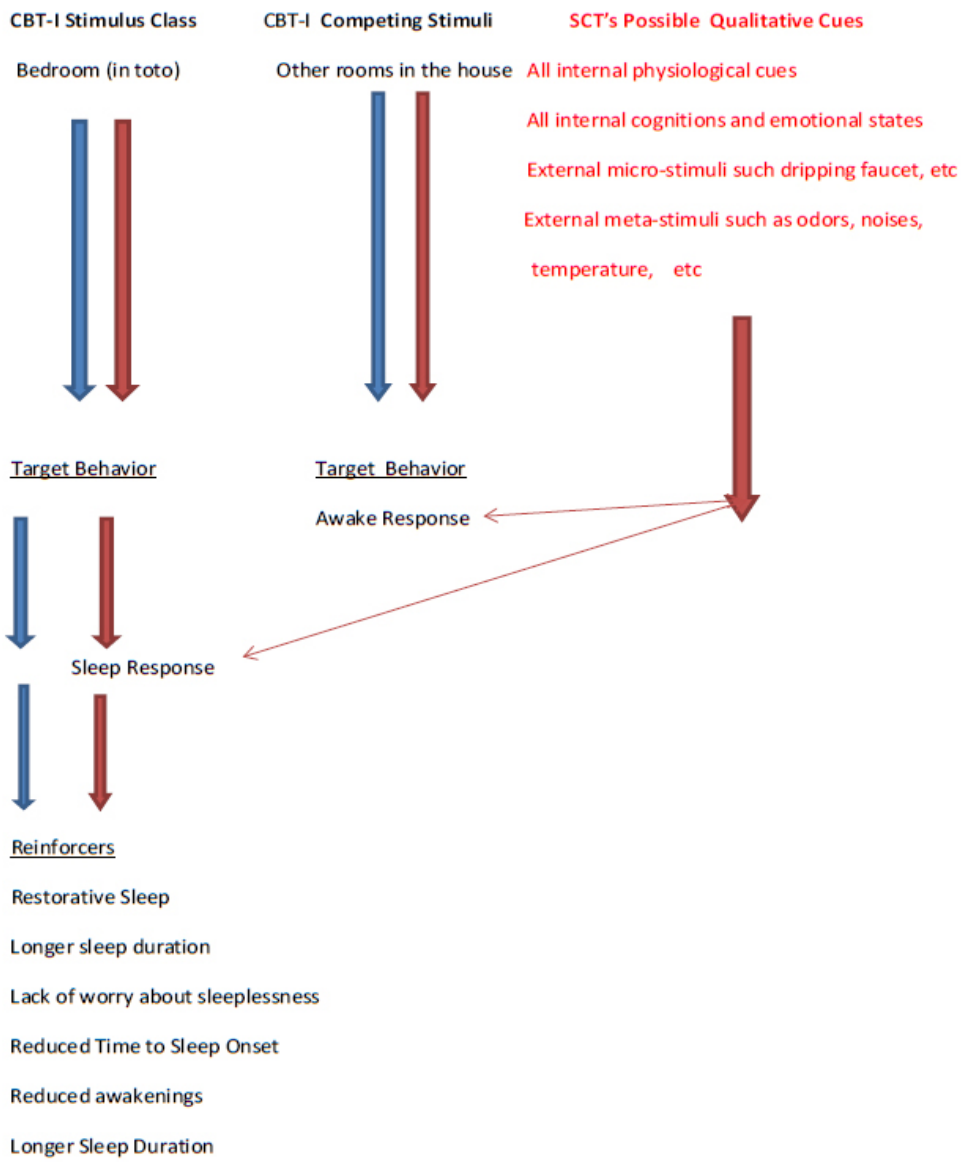

Figure 1: CBT-I Model vs. SCT Model of Optimal Stimulus Control of Sleep/Wake Stimuli

wake-onset cues in the bedroom? Clearly, the largest object in a room, the bed, should trigger the physiological relaxation response and the mental desire to relax, relinquish control and luxuriate in deep restorative sleep. When that doesn't happen, the patient may associate the bedroom with worrying, fretting, and tiredness that is accompanied by an inability to sleep. What is interesting is that the insomniac often confines the bedroom arousal/worry cues to THEIR bedroom and THEIR bed. When they go to a hotel or to visit friends they often sleep much better – some even have normal sleep patterns outside their own home. Clearly, they have learned to discriminate the bedroom cues for sleep. It is not any bed or any pillow that provokes the conditioned arousal. It is their pillow and their bed that are the discriminative cues. Given that individuals can differentiate bed cues, it is very likely that they can create multiple differential sleep and wake cues within their own bedroom, especially if trained to do so.

An eliciting (i.e. discriminative) stimulus is a stimulus that elicits the right behavior at the right time. A stop light is the quintessential discriminative stimulus. When it is green, you proceed. The same exact light, elicits totally different behavior when it is red. We learn that it is not the stoplight that is the discriminative cue that we need to attend to if we don't want to be in an accident, it is the colored lights on the face of the stop light. There are always thousands of potential stimuli in our environment that can control our attention and our behavior. Some of these stimuli are social,

some environmental, and some internal. We learn to respond to very detailed and complex discriminative stimuli.

Any of the stimuli that are preceding a particular behavior (the antecedent stimuli) or accompany the behavior (the concurrent stimuli) are capable of becoming, through classical conditioning, discriminative stimuli that independently can evoke the behavior. The discriminative stimuli gain control over the behavior because it has been reinforced (paired with the desired result – sleep). For example, a person may choose to swear at home when frustrated but refrain from using those same swear words when frustrated and trying to close a deal with a customer at work. Swearing, in this case, is under two sets of discriminative stimuli. The home setting is the green light and the work setting is the red light. Both settings have stimulus control over the behavior – only one in facilitating the behavior and the other is inhibiting the behavior.

In the bedroom there are multiple stimuli that are discriminative stimuli. Some may be acting as red lights for sleep behavior and some as green lights. The insomniac needs to learn to master both sets of discriminative stimuli – ignoring arousal cues and attending to sleep cues when sleep onset is desired. Clients need to learn to emit sleep enhancing responses in the presence of discriminative bedroom stimuli and inhibit sleep responses in the presence of non bedroom stimuli. Both sets of stimuli need to be very distinct and different from one another.

When one is instructed to go to another room, in the middle of the night, and sit quietly till they are sleepy, there are two potential negative impacts on healthy sleep patterns. First, they are entering an environment filled with cues for arousal – not sleep. Living rooms and kitchens are used for daytime events. The cues are all wrong. Second, they are pairing their sleepy state with the darkened living room or den. Over time, this could definitely increase the chances of nighttime napping while reading or watching TV in these rooms. Again, you don't want feelings of extreme tiredness and sleepiness to be associated with rooms outside the bedroom.

Sleep restriction procedures ensure that when a person goes to bed, they are tired. If they are not getting to sleep under sleep restriction interventions, perhaps the cues in the room are insufficient to bring in the sleep response and more discriminative cues should be added to the situation. Theoretically, the idea of introducing discriminant cues to the bedroom situation makes as much sense (if not more sense) than moving a person to a non sleep room with its attendant wake stimuli.

The ability to create discriminative bedroom stimuli is only limited by the imagination of the therapist and the environmental sensitivities of the patient. For some, the gestalt of bedroom cues is best handled by leaving the room entirely (the traditional SC being discussed). But for many this is not desirable, possible, or effective. Take the situation of college students living in dorm room. Facing one wall could be the cues for arousal and facing the other wall could be the cues for sleep. Many people intuitively use body positions as discriminative cues – they lie in bed relaxing in one position and then immediately shift their body to another position for sleep onset. The author has had handicapped individuals use favored pieces of cloth (sort of an adult transitional object) that can be draped near the pillow to signal sleep onset. In summary, while the theory of stimulus control cannot easily or harmoniously be applied to current stimulus control techniques, the concept does offer multiple within-the-room avenues for intervention.

One theoretical explanation that might explain the stimulus control problems with insomniacs is "stimulus over-selectivity". Stimulus over-selectivity occurs when a person focuses on only one aspect of an object or environment while ignoring other equally important aspects. The original demonstration of this phenomena involved rewarding autistic children for pressing a lever whenever they were cued with three different simultaneously presented stimuli (i.e., a light, a sound, and a touch). After they learned the task, the three stimuli were unbundled and presented individually. The results showed that the children were using only one cue to learn the task and ignoring the others. For example, a child would press the lever when a light was presented, but he/she did not press the lever when the sound was presented alone nor when the touch was presented alone [15]. Since this discovery, the phenomena has been shown to occur in many, many groups including the elderly [16], normal children [17]. and adults [18] – although, the incidence of over-selectivity is much more common as one ages and in developmentally disabled individuals. Perhaps, insomniacs are over-attending to particular arousing cues in the bedroom and ignoring many of the co-occurring relevant sleep inducing cues. Indeed, the aim of removing TVs and clutter from the bedroom is precisely to reduce the incidence of arousing cues. However, even when the obvious cues are deleted, many idiosyncratic cues may still exist. Research exploring this area may prove to be very valuable and lead to techniques that help insomniacs focus on specific sleep inducing cues they have been ignoring in the bedroom environment. There is research that shows that relaxation and mindfulness training reduce the tendency to over-select stimuli [16].

The non-controversial components of stimulus control (go to bed only when sleepy, keep same wake and sleep times, no napping, use bed only for sleeping) are all potentially strong zeitgebers that affect the circadian rhythm as well as creating potent sleep stimuli while in the bedroom. It is unlikely that the LTB technique can act as potent a zeitgeber as the other components of stimulus control, since it is not a daily rhythm but rather an interruption of a daily rhythm. The therapeutic value of daily rhythms is increasingly

being recognized in many aspects of psychotherapy. Social rhythm therapy, for example, involves maintaining regular daily rhythms in activities such as sleeping, waking, eating, and exercise. It was developed to treat bipolar patients (who are notorious for sleep problems) and has been found to increase quality of life, reduce symptoms, and help prevent relapse [19]. This suggests that stimulus control theory could help generate develop additional rhythms to reinforce the sleep-wake schedule even further.

There is a Lack of Compliance among Insomnia Patients Exposed to CBT-I to Leave the Bedroom upon Nighttime Awakenings.

Somewhere between one in five to one in four insomniacs (19 % and 26%), who complete a course of treatment, fail to show a clinically significant response to CBT-I. Sleep Training Restriction (STR) and stimulus control (SC) are the "core components" of CBT-I [20] (Morin, Culbert, & Schwartz, 1994). Most of these people were unable to comply with the treatment recommendations. Chambers (1992) [21] reported that of 103 insomnia patients treated at the Stanford Sleep Clinic, fewer than 30% had followed the recommended procedures "very closely." DiMatteo and DiNicola (1982) [22] estimated compliance for a long-term behavioral program begins at about 50% and declines steadily as the program continues. The biggest barriers to compliance include self-efficacy, affective reactions to treatment and cognitive appraisals of the ongoing effects of treatment. LTB strategies can potentially decrease compliance on at least four fronts:

a. Most insomniacs who do not comply with treatment already suffer from a lack of self efficacy about finding successful sleep strategies. They lack the internal images of persistence and eventual success needed to provide the motivation to continue treatment (Perlis et. al., 2004; Vincent et. al., 2008) [3,4]. They cannot imagine themselves having the were-with-all to move in and out of the bedroom, in the middle of the night, when they are groggy or anxious and waiting to sleep.

b. The most significant emotional barriers to treatment include annoyance, boredom, anxiety, and discomfort. Vincent et. al. (2008) [4] reports a highly significant correlation of -.66 between perceived barriers and adherence to stimulus control instructions. After one or two nights of unsuccessful LTB attempts, the extreme daytime sleepiness reinforces a sense of despair and the sense that one is doomed to suffer with insomnia. The despair makes "giving up" on the treatment directives more likely. Fears about daytime functioning also are likely to reduce compliance on subsequent nights. The perceived barriers and compliance/adherence relationship suggests that for those clients who perceive barriers to leaving the room, successful insomnia treatment requires modifying the stimulus control instructions. Alternative stimulus control interventions are needed that are grounded in learning theory, theoretically likely to succeed in creating new sleep onset cues and clinically likely to increase compliance.

c. Behaviorally, stimulus control requires that the patient be actively engaged in extra activities during the night (most importantly getting out of bed and going into a different room multiple times). Patients who arouse themselves enough to go to a different room are being primed to focus on the daytime sensations of sleepiness. They are more likely to ruminate over daytime dysfunction because they are more cognitively aware of how much sleep disruption has occurred during the night.

d. Interpersonally, individuals worry that getting in and out of bed for various lengths of time will be disruptive to their bed partner [4].

There are Contra-Indications to Stimulus Control for Specific Populations

The elderly have a very high incidence of sleep problems. However, because of frailty and medication effects it is often NOT advisable to tell them to get out of bed in the middle of the night. Other groups for whom this is a problem include college students in dorms, military service personnel, assisted living residents, and individuals who live in crowded apartments where there is no "extra room" that is dark and quiet. Also excluded from LTB techniques are those with mania, epilepsy, and parasomnias. On top of that, many, many people are resistant to leaving the bedroom once they get in bed (undoubtedly due, in some small part, to long term conditioning about the length of time you should stay in bed!)

There is the Availability of Better Treatment Options to Develop Discriminative Stimuli for Sleep Onset

If we reduce the frequency with which we tell people to leave the bedroom after a long unsuccessful sleep onset period or during the middle of the night awakenings , what behavioral prescriptions are likely to be more successful in facilitating sleep? I would like to offer a few likely prescriptions to be added to the LTB alternative, all of which are already being used when LTB is not an option.

a. As demonstrated by Zwart et. al. (1979) [11], telling people to remain in bed, sit up and engage in some routine activity till sleepy, whether it be knitting, reading, drinking or eating some snack by the bedside, works as well as leaving the room. We should try this strategy first since it is the easiest to implement and most appealing to most patients.

b. Successful sleep inducing results have been reported by utilizing mild yoga relaxation poses. Teaching people go into the baby pose on the bed for a few minutes or lying flat on the floor in their bedroom and raising their legs to straddle the wall for a few minutes can induce greater levels of relaxation and facilitate sleep onset.

c. Listening to the radio, television, or I-Pods on a low 60 dc range (sounds just above a whisper do not usually interfere with

sleep onset or sleep maintenance) helps distract individuals from ruminating and lower arousal levels to facilitate sleep.

d. Paradoxical interventions have been shown in one study to be as effective as stimulus control (Turner and Asher, 1979) [12,13]. This general procedure could be more fully investigated and adapted to individual sleep styles.

In closing, I would like to suggest that we need more randomized clinical trials (RCTs) to assess both the efficacy and effectiveness of the various treatment components that are routinely included in the CBT-I toolbox. Stimulus control is one of the most basic principles in learning theory, yet its application to real life clinical problems, such as insomnia, is complex and inter-related with multiple other factors. Stimulus control is a potent concept and we have helped many people sleep better by applying our knowledge in this area. As we gain further understanding of stimulus control and its application to insomnia, we may be able to reach many of those who are currently not responsive. We need to find out which interventions work for which individuals under what type of social and environmental supports and which interventions are contra-indicated for specific individuals under which type of restrictions and high risk factors. We need to develop clinical interviewing strategies, validated questionnaires and laboratory based assessment techniques to find out which stimuli in the bedroom actually are associated with lowered arousal and which are associated with heightened arousal. For example, having clients describe their bedrooms or bring in pictures of the bedroom or other rooms in the house could facilitate productive lines of clinical inquiry. To assess controlling stimuli that may be outside the client's conscious awareness, heart rate sensors and respiration sensors could be used within a standardized virtual reality (VR) protocol that measures arousal to a range of single stimuli and contextualized stimuli. Hopefully, such clinical tools will facilitate more effective treatments.

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