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## Understanding how Bright Light Affects Circadian Rhythm Disorders

*Note: This article is not intended as medical advice. One should always consult with a doctor when considering light therapy.*

An estimated 35 million Americans suffer from Seasonal Affective Disorder (SAD). Most scientists believe that SAD and other mood and sleep disorders are associated with shifted circadian rhythms (i.e. body clock). Those with 'weak' circadian rhythms need a very bright stimulus of light to reset their body clock each day. When they don't receive this light signal, their body clocks either speed up (Advance) or slow down (Delay). This "Out of Whack," body clock then produces the wrong hormones at the wrong time of day, causing the symptoms of SAD and other mood and sleep disorders.

Bright light (10,000 lux intensity) has been found to be the only effective means of shifting circadian rhythms. This article attempts to explain how bright light can re-shift delayed and advanced circadian rhythms back to their normal pattern.

### DELAYED CIRCADIAN RHYTHM

Approximately 7% of the population has a weak circadian system. Of this group, 80% will suffer from Delayed Circadian Rhythm Disorder (DCR), and need a very strong stimulus of bright

light to reset their internal clocks each day. When they don't get this stimulus, their body clock will migrate to a later time of day until it receives a strong enough stimulus of light.

Most people with Delayed Circadian Rhythm disorders also suffer from sleep problems. They experience difficulty getting up in

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the morning, have a tough time at school or work, and usually have trouble falling asleep until 1 or 2 am. Their subjective morning has probably shifted to noon or even later. This is known as Delayed Sleep Phase Syndrome (DSPS). Most people who suffer from Delayed Circadian Rhythms also have DSPS.

### Treatment for DCR and DSPS

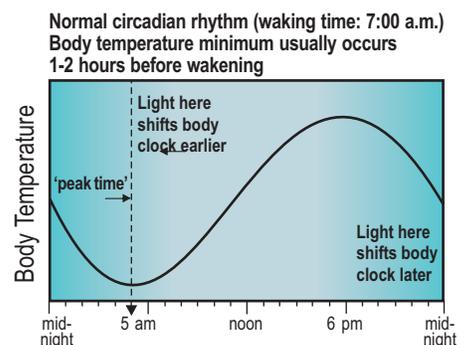
Often people will complain of Seasonal Affective Disorder without having the sleep problems of DSPS. However, the treatment is the same. If a person has a difficult time in the morning or day regardless of sleep problems, he/she should use the lightbox in the morning.

### TREATMENT OF DELAYED CIRCADIAN RHYTHMS

The treatment of circadian rhythm disorders is based on the hypothesis that the body's internal clock will only respond to bright light at a certain time of day. This 'peak time' for people with normal circadian rhythms occurs when they are in R.E.M. sleep, approximately 1 to 2 hours before awakening.

### 'Peak Time' Corresponds to Minimum Core Body Temperature

Sleep labs can determine this peak time by body temperature. When the body temperature drops almost a full degree, the pineal



gland in the brain is most receptive to light. Light received just prior to this 'peak time' will delay the circadian rhythm and push the body clock forward, *causing the person to wake up later*, while light received just after will advance the circadian rhythm, *causing the person to wake up earlier*.

With DCR, when no bright light stimulus is given, the body's clock will shift on its own to a later time. So the trick is to get light *after the subjective peak time*, so that it resets the body clock to an earlier time of day. The brain will only be receptive to light therapy within a two to four hour window from this peak time, and the effect is greater when light is received closer to the peak time.

It is also important to avoid any bright light before this peak time, as this might further delay the body clock and exacerbate the problem.

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### **Determining Body Temperature Minimum**

Although most people are unable to go to a sleep lab to determine their body temperature drop, they can get pretty close by examining their *natural* sleep/wake cycle. If one is allowed to sleep in, he/she should usually wake up approximately one to two hours after this 'peak time'. For example, if the person wakes up around 2 pm, his/her subjective peak time would be around noon. If

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a very strong stimulus of light is received just after noon (for at least 30 minutes), it will reset the body clock as much as two hours earlier.

The next day bright light could be received as early as 10:00am or 10:30am. Each succeeding day the time can be set as much as 2 hours earlier until he/she is waking up at 7 am or earlier.

The body's internal clock can be pushed or reset as much as two hours per day, although one hour per day is more advisable. With this schedule, bright light could be received Saturday at noon, and by Monday the person could be waking up at 8 am or 7 am.

### **Reducing Treatment Time**

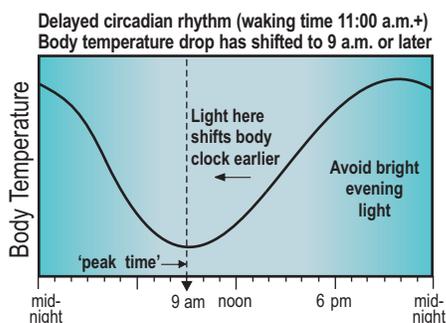
Once this new schedule is set, and one is responding well to it, he/she may not need to continue using the lightbox for a full 30 minutes. After a week or two, most people can reduce their treatment schedule to 20 or even 15 minutes /day.

Doctors also recommend wearing dark sunglasses for the first few days in the morning while resetting the body clock to an earlier time. For example, if one receives a bright stimulus of light at noon, he/she must avoid any bright light before that time because it may push the body clock in the wrong direction. Using sunglasses each day until the internal clock is reset to the proper time will help avoid this problem.

### **Secondary Instructions**

The majority of people with Delayed Circadian Rhythm Disorders do very well with just morning light. However, some find after a few weeks that they still haven't achieved the desired effect. They lose energy in the late afternoon or evening. Additional relief may be found by using the lightbox in the late afternoon or evening as well, but with one exception: One must stay at least twice as far away from the lightbox in the evening as he would for morning use.

Staying twice as far away in the evening will reduce the intensity to approximately 2,500 - 3,000 lux and thus won't confuse the brain into thinking that it is time to reset its body clock. If the brain receives the same intensity in the morning and evening, it could cancel the effect of morning light and not be as effective.



### **ADVANCED SLEEP PHASE SYNDROME**

Approximately 20% of those with weak circadian rhythms suffer from Advanced Sleep Phase Syndrome (ASPS). In this case, their body clocks tend to speed up when they don't get a strong enough stimulus of light. Their body clock will advance to an earlier time of day.

Most people in this category fall asleep easily, and usually earlier at night. However, they can only stay

asleep for a few hours and are up again. Many cannot get back to sleep and finally get out of bed in the early morning. Others might get another hour or two of sleep before they awaken. In either case, they don't need an alarm clock to wake them up, and they usually get out of bed because they just can't get any more sleep. ASPS is also

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more common in (but not limited to) the elderly population. Apparently, some body clocks may tend to speed up with age.

### Similarities in both DSPS and ASPS

In both DSPS and ASPS, sufferers may experience insomnia during the night time. However, the rule of thumb is if the person falls asleep easily, but only gets a few hours of consistent sleep, he/she should try the lightbox in the evening.

### Treatment Schedule for ASPS

Whereas DSPS requires that light be administered within an hour or two after the body temperature minimum, ASPS can be effectively treated with evening light (6 to 9 pm). However, finding the optimum time to use evening light is more difficult. Doctors will recommend starting at 6:00pm or 7:00pm for one to two weeks and then moving an hour later for a few days, and then another hour later etc. until the desired wake-up time is reached.

Light should not be administered past 9 pm. Bright light will suppress the production of the sleep inducing hormone, melatonin, and it usually takes a couple of hours before melatonin will again be released. If bright light is used past 9:00 pm., it will be difficult to fall sleep until after 11:00 pm.

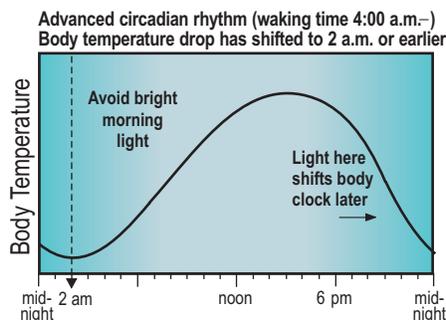
### Morning Vs. Evening Light

ASPS affects the minority of SAD sufferers, and the symptoms may not be as easy to recognize as DSPS. If there is any question whether morning light or evening light should be used, most doctors will recommend using morning light for a couple of weeks and then switching to evening light if no benefit was found from using morning light.

### ADAPTING TO SHIFT WORK

Instructions for ASPS are virtually the same for shift work even though the shift worker may not suffer from either DSPS or ASPS. Receiving bright light in the evening time while avoiding morning light will shift the body clock to a night schedule.

The shift worker must first determine when he/she wants to wake up, and receive bright light at that time. Care must be taken to avoid any bright light when coming home from work and going to bed. This schedule should shift the body clock within a week.



### ACCELERATING CIRCADIAN SHIFTING WITH MELATONIN

Shifting the body clock can be accelerated by using melatonin in conjunction with bright light. A small dosage of melatonin (1 to 3 mg) can be taken approximately 12 hours after bright light is received. This can help move the body clock as much as four to six hours each day, in either direction.

### Shifting from Day Schedule to Night

Because the circadian shift can be greater with melatonin, it may be easier to *accelerate* the body clock to the desired wake/sleep time. For example, one could shift his body clock from morning to evening by using the following schedule:

<u>Day</u>	<u>Bright Light</u>	<u>Melatonin</u>
1	6:00 am	6:00 pm
2	2:00 am	2:00 pm
3	10:00 pm	8:00 am

After the third day, one could be receiving bright light at the desired wake time, and not have to take any more melatonin.

### Shifting from Night to Day Schedule

The schedule for shifting from night to day is the reverse of the previous schedule, but with one exception. It is important to avoid bright light before each light session.

<u>Day</u>	<u>Bright Light</u>	<u>Melatonin</u>
1	6:00 pm	6:00 am
2	2:00 pm	2:00 am
3	10:00 am	10:00 pm

Once the desired shift is achieved, light should be received at the regular, new wake-up time.

### Cautions With Melatonin

Since most of the effort in shifting circadian rhythms requires the *suppression* of melatonin, light

is the most effective means of shifting rhythms. Therefore, melatonin should not be considered solely effective in shifting the body clock. It is also very important to avoid any bright light while melatonin is active in the system. Time release melatonin also seems to be more effective than regular melatonin.

### **Cautions and Recommendations for Shift Work**

The greatest difficulty people have with shift work is inconsistent schedules. Shifting circadian rhythms works best when a person only needs to shift every month or so. Constant rapid shifting is very difficult on the body.

Shift workers often receive conflicting light signals at the wrong time for their shift. Constant exposure to conflicting light signals will weaken the circadian rhythm system and cause fatigue.

### **Recommendations for Shift Workers**

The most helpful advice for shift workers is to receive a consistent schedule of light, regardless of the shift schedule. For example, if someone must shift schedules every few days, the best strategy would be to receive bright morning light every day.

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*The most helpful advice is to receive bright morning light every day, while using a lower intensity of bright light at night to suppress melatonin.*

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### **Using a Bright Light During the Night Shift**

Although shift workers may not be able to use bright light to shift their rhythms, they can find considerable relief by using the light to suppress melatonin while working at night. A 10 to 15 minute burst of light is sufficient to suppress melatonin for approximately three hours at a time. One would only need to take a short 'light break' three times during the night. It is important **NOT** to stay within the 10,000 lux distance of the light. 1,000 lux to 2,500 lux is sufficient to suppress melatonin without resetting the body clock, and it is very important for shift workers to maintain a constant circadian rhythm.

### **ADJUSTING FOR JET LAG**

Again, since most of the effort in shifting circadian rhythms requires the suppression of melatonin, bright light is the most effective means for treating jet lag. Used properly, one should be able to avoid jet lag altogether. It is much easier to reset ones body clock before arriving in the new time zone.

### **Traveling East**

When traveling east, one should *advance* his body clock. The number of time zones traveled corresponds to the hours needed to shift. A few days before leaving, he should advance his body clock a few hours each day using the schedule described in "Shifting from Day to Night." Sleep schedules should also be adjusted each day. Upon arrival, any sunlight must be avoided before 10:00 am (by wearing sunglasses).

When returning, one should use bright evening light for a few nights and avoid any morning light.

### **Traveling West**

When traveling west, one must *delay* his body clock. The schedule

for "Shifting from Night to Day" should be used.

When returning home, one should avoid any bright afternoon and evening light while receiving bright morning light for a few days.

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*Understanding how the body reacts to light signals allows one to better control the sleep/wake cycle.*

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### **CONCLUSION**

This information should prove helpful in understanding circadian rhythm and sleep problems associated with circadian rhythm disorders. Understanding how the body reacts to light signals allows one to better control the sleep/wake cycle, and also effectively adjust for shift work or jet lag.