

## The Acute Effects of Light on Sleep-Wake Behaviors



*A group of neurons in the intergeniculate nucleus stained with the immediate early gene, FOS, when the rat is exposed to an abrupt shift from darkness to light.*

Abrupt changes in lighting conditions have a profound effect on behavior, regardless of whether these changes in illumination occur during the day or the night. What components of the visual system are involved in mediating the effects of acute changes in lighting on sleep patterns? In collaboration with Dr. Ruth Benca (Department of Psychiatry), we have begun to explore this question. Our initial findings indicate that the superior colliculus and pretectum are involved. In particular, removal of the pretectum eliminates the characteristic REM sleep triggering response that is seen in albino rats following a light-to-dark transition. Using FOS immediate early gene expression, we have localized neurons in small regions of the pretectum that are active during acute light-dark transitions. Some pretectal nuclei are particularly responsive at midnight, others at midday, suggesting that the illuminance detection system is linked to the circadian system. We next asked the question: does rearing rats in continuous dark or continuous light have an impact on sleep, or on the response to acute changes in lighting conditions? Preliminary findings from dark-reared rats show a reduced retinal input to subcortical visual structures. Interestingly, these rats show no changes in overall sleep and wakefulness. However, they do show enhanced REM triggering in response to light-dark transitions, suggesting that disturbances in illumination during development have lasting effects on aspects of sleep-wake behavior. We hope these studies will lead to a better understanding of how light affects normal

individuals as well as those with seasonal depression, and pre-term infants that have been exposed to continuous illumination in hospital settings. These studies are supported by the [National Institutes of Mental Health](#).

### Publications Relative to This Topic:

Miller, A.M., W.H. Obermeyer, M. Behan and R.M. Benca. 1998 Effects of superior colliculus-pretectal lesions on sleep: a novel site for mediating light induced sleep-behaviors. Proc. Natl. Acad. Sci. 95: 8957-8962. [\[Abstract\]](#) [\[Full Text\]](#) [\[Full Text \(PDF\)\]](#)

Miller, A.M., R.B. Miller, W.H. Obermeyer, M. Behan and R.M. Benca. 1999 The pretectum mediates rapid eye movement (REM) sleep regulation by light. Behav. Neurosci. 113:755-765. [\[Abstract\]](#)

Prichard, J.R., Stoffel R.T., Quimby, D.L., Obermeyer, W.H. Benca, R.M. and M. Behan, 2002. Fos immunoreactivity in rat subcortical visual shell in response to illuminance changes. Neuroscience 114:781-793. [\[Full text\]](#)

Prichard, J.R., Fahy, J.L., Obermeyer, W.H., Behan, M. and Benca, R.M, 2004. Sleep responses to light and dark are shaped by early experience. Behav. Neurosci. 118:1262-1273 [\[Abstract\]](#)