Abstracts Rhythmicity/Shift work

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How to use light and dark to produce circadian adaptations to night shift work. Psychology Department, Rush-Presbyterian-St. Luke's Medical Centre, Chicago, IL 60612, USA

The circadian rhythms of night shift workers so not usually adjust to their unusual work and sleep schedules, reducing their quality of life an producing potentially dangerous health and safety problems. This paper reviews field studies of simulated night work in which shifted light-dark cycles were constructed with artificial bright or medium-intensity light to produce circadian adaptation, i.e. the shifting of circadian rhythms to align with night work and day sleep schedules. By using these studies we describe fundamental principles of human circadian rhythms relevant to producing circadian adaptation to night shift work at a level designed for the reader with only a basic knowledge of circadian rhythms. These principles should enable the reader to start designing work/sleep-light/dark schedules for producing circadian adaption in night shift workers. One specific schedule is presented as an example. Finally, we discuss phase-response curves to light and clarify common misconceptions about the production of circadian rhythm phase shifts.

Campbell SS; Eastman CI; Terman M; Lewy AJ; Boulos Z; Dijk DJ.

Light treatment for sleep disorder: consensus report. I+ Chronology of seminal studies in humans. Laboratory of Human Chronobiology, New York Hospital, Cornell University Medical College, White Plains, NY 10605, USA.J Biol Rhythms, 1995 Jun, 10:2, 105-9

Examination of the influences of the light-dark cycle on circadian rhythmicity has been a fundamental aspect of Chronobiology since its inception as a scientific discipline. Beginning with Bünning's hypothetical phase response curve in 1936, the impact of timed light exposure on circadian rhythms of literally hundreds of species had been described. The view that the light-dark cycle was an important zeitgeber for the human circadian system, as well seemed to be supported by early studies of blind and sighted subjects. Yet, by the early 1970s, based primarily on a series of studies conducted at Erling-Andechs, Germany, the notion became widely accepted that the light-dark cycle had only a weak influence on the human circadian rhythm and that social cues played a more important role in entrainment. In 1980, investigators at the National Institute of Mental Health reported that bright light could suppress melatonin production in humans, thereby demonstrating unequivocally powerful effects of light on the human central nervous system. The finding led directly to the use of timed bright light exposure as a tool for the study and treatment of human circadian rhythms disorder.

Eastman CI; Boulos Z; Terman M; Campbell SS; Dijk DJ; Lewy AJ.

Light treatment for sleep disorders: consensus report. VI. Shift work. Biological Rhythms Research Laboratory, Rush-Presbyterian-St. Luke's Medical Centre, Chicago, IL 60612, USA.J Biol Rhythms, 1995 Jun, 10:2, 157-64.

The unhealthy symptoms and many deleterious consequences of shift work can be explained by a mismatch between the work-sleep schedule and the circadian rhythms. This mismatch occurs because the 24-h zeitgebers, such as the natural light-dark cycle, keep the circadian rhythms from phase shifting to align with the night-work, day sleep schedule. This is a review of studies in which the sleep schedule is shifted several hours, as in shift work, and bright light is used to try to phase shift circadian rhythms. Phase shifts can be produced in laboratory studies, when subjects are kept indoors, and faster phase shifting occurs with appropriately timed bright light than with ordinary indoor (dim0 light. Bright light field studies, in which subjects live at home, show that the use of artificial nocturnal bright light combined with enforced daytime dark (sleep) periods can phase shift circadian rhythms despite exposure to the conflicting 24-h zeitgebers. So far, the only studies on the use of bright light for real shift workers have been conducted at National Aeronautical and Space Administration (NASA). In general, the bright light studies support the idea that the control of light and dark can be used to overcome many of the problems of shift work. However, despite ongoing practical applications (such as NASA), much basic research is still needed.

Horowitz TS, Cade BE, Wolfe JM, Czeisler CA.

Efficacy of bright light and sleep/darkness scheduling in alleviating circadian maladaptation to night work. Division of Sleep Medicine, Department of Medicine, Boston, Massachusetts 02115, USA ResultsAm J Physiol Endocrinol Metab 2001;281(2):E384-91.

We tested the hypothesis that circadian adaptation to night work is best achieved by combining bright light during the night shift and scheduled sleep in darkness. Fifty-four subjects participated in a shift work simulation of 4 day and 3 night shifts followed by a 38-h constant routine (CR). Subjects received 2,500 lux (Bright Light) or 150 lux (Room Light) during night shifts and were scheduled to sleep (at home in darkened bedrooms) from 0800 to 1600 (Fixed Sleep) or ad libitum (Free Sleep). Dim light melatonin onset (DLMO) was measured before and after the night shifts. Both Fixed Sleep and Bright Light conditions significantly phase delayed DLMO. Treatments combined additively, with light leading to larger phase shifts. Free Sleep subjects who spontaneously adopted consistent sleep schedules adapted better than those who did not. Neither properly timed bright light nor fixed sleep schedules were consistently sufficient to shift the melatonin rhythm completely into the sleep episode. Scheduling of sleep/darkness should play a major role in prescriptions for overcoming shift work-related phase misalignment.