White Light of Different Spectral Composition Causes Differential Phase Shifts of Circadian Rhythm of Activity in a Bat

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Free-running circadian rhythms are phase-shifted by pulses of light, temperature, or chemicals. A phase-response curve (PRC) is obtained when phase shifts are plotted as a function of phases being perturbed [1]. Here we report that for the subjective night phases in a bat the phase shifts differ in sign when evoked with pulses of white light of equal intensity and duration but of differing spectral composition.

White light pulses of 1000 lx for 15 min duration were administered at various phases of the circadian rhythm of flight activity in the cave-dwelling bat, *Hipposideros speoris,* free-running in continuous darkness (DD). The procedure for the maintenance of bats, method of data analysis, and derivation of PRC have been described [2]. Two PRCs had been previously obtained with white light pulses of daylight [3] and fluorescent light [2]. We have now constructed an incandescent light PRC. The spectral intensity distribution curves for daylight, fluorescent light, and incandescent light are shown in Fig. 1.

Figure 2 shows the daylight, fluorescent light, and incandescent light PRCs. The incandescent light PRC deviates from the daylight or fluorescent light PRC particularly for the subjective night phases (CT 14 to CT 24). The incandescent light pulses evoked pronounced advance phase shifts for the subjective night phases, whereas the

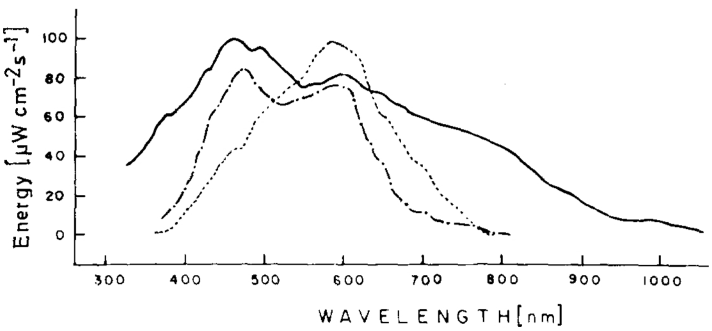

Fig. 1. The spectral intensity distribution curves for about 1000 lx of diffuse daylight (———), the incandescent cool light (--------) (Schott Mainz KL150E cool light source fitted with a Halogen Bellaphot lamp, Osram, 15 V 150 W) and the fluorescent light (—·—·—·) (Philips tube light, 240 V, 20 W, 6500 K)

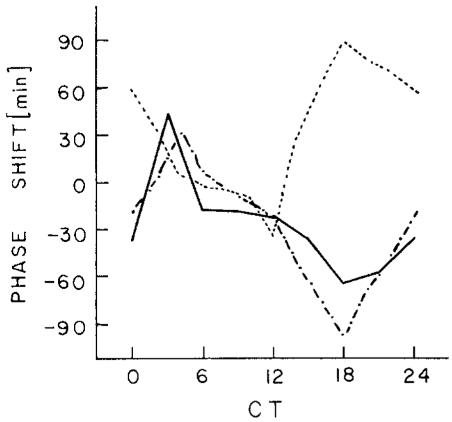

Fig. 2. Three PRCs for *H. speoris* evoked with white light of different spectral composition but of equal pulse strength (1000 lx for 15 min) given against DD background. The curves are obtained by drawing straight lines through medians. PRC for daylight (———), fluorescent light (—·—·—·) and incandescent light (--------). The daylight and fluorescent light PRCs are redrawn after [3] and [2], respectively

daylight and fluorescent light pulses evoked pronounced delay phase shifts for the same phases. This might be attributed to the differences in the spectral intensity distribution curve for the incandescent light from those of the daylight and fluorescent light. The incandescent light curve has a single peak at about 600 nm, whereas the daylight and fluorescent light curves have two peaks: one at about 430 nm and the other at about 600 nm (Fig. 1).

Differential responses to natural dawn and dusk twilight were also observed in entraining these bats (Joshi and Chandrashekaran, in preparation). Dawn twilight was effective in advancing the onset of activity, whereas the dusk twilight of the same duration was effective in delaying the onset of activity. The differential responses may once again be due to the one of the two photoreceptor classes [2] responding selectively to dawn or dusk twilight. Such differential responses to light in *H. speoris* may have ecological significance.

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