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Resetting Effects of Light on the Mammalian Brain Clock

Many variables in physiology and behavior have a 24-hour rhythm. These rhythms, termed "circadian" (from the Latin: *circa:* about, and *diem:* day), continue even when there are no external environmental signals. The suprachiasmatic nucleus (SCN) of the hypothalamus is the structure of the brain that has been identified as the "clock" and serves the dual function of generating these rhythms (even in the absence of environmental cues) and entraining (synchronizing) them to the environment when cues are present. Information about the external light-dark cycle reaches the SCN by the retino-hypothalamic tract (RHT), a monosynaptic projection from the retina. Recent studies have suggested that the SCN achieves both functions of rhythm generation and rhythm entrainment through the collaboration of different types of cells: ones that are rhythmic (in their firing, gene expression, etc.) and others that are not rhythmic but are activated by light. Indeed, light has the ability to shift circadian rhythms. When presented early in the night, light produces phase-delays, when presented late in the night, phase advances. The goal of the current project was to investigate the time-of-day dependent differences in light induced phase-shifting. Using double-label immunocytochemistry, timeline for the cell types activated in the SCN following light stimulation was constructed. We show that different cell phenotypes may be activated along different time courses, depending upon the direction of the phase-shift (advance vs. delay). Understanding the mechanisms by which light phase-shifts the brain clock will help in the treatment of a number of human health issues, including jet-lag and shift-work disorders.