The circadian clock located within the suprachiasmatic nuclei (SCN) of the hypothalamus responds to changes in the duration of day length, i.e. photoperiod, differently in the separate SCN parts. The aim of the study was i) to compare the effect of a long and a short photoperiod with twilight relative to that with rectangular light-to-dark transition on the daily profiles of clock gene expression and their protein levels within the rostral, middle and caudal regions of the mouse SCN; ii) to elucidate the dynamics of adjustment to a change of a long photoperiod to a short photoperiod of clock gene expression rhythms in the mouse SCN and in the peripheral clock in the liver, as well as of the locomotor activity rhythm; iii) to elucidate whether and how swiftly the immature rat fetal and neonatal molecular SCN clocks can be reset by maternal cues and iv) to reveal when and where within the rat SCN the photic sensitivity of clock gene expression develops during the early postnatal ontogenesis and to compare it with development of cfos photoinduction. Mice and rats were used for experiments; their tissues were analyzed by in situ hynridization, immunohistochemistry, RT-PCR. The data indicated that i) the twilight photoperiod provides stronger synchronization among the individual SCN cell subpopulations than the rectangular one, and the effect is more pronounced under the short than under the long photoperiod; ii) different mechanisms of adjustment to a change of the photoperiod in the central SCN clock and the peripheral liver clock; iii) SCN clock is capable of significant phase shifts at fetal developmental stages when no or very faint molecular oscillations can be detected; iv) light sensitivity of the circadian clock develops gradually during postnatal ontogenesis before the circadian clock starts to control the response.