In mammals, circadian rhythms are orchestrated by the suprachiasmatic nucleus (SCN) of the hypothalamus, which aligns internal clocks with external light-dark cycles. Light information is conveyed via intrinsically photosensitive retinal ganglion cells (ipRGCs) that express melanopsin. Within the SCN, vasoactive intestinal peptide (VIP) neurons synchronize network oscillations, whereas arginine vasopressin (AVP) neurons act as output cells transmitting circadian timing to downstream targets.

While previous studies have focused on ipRGC input to VIP neurons, emerging single-cell tracing data suggest that ipRGCs may also directly innervate AVP neurons. Given that AVP neurons are critical determinants of circadian period length and stability, we hypothesized that ipRGCs can directly modulate AVP neuron activity, thereby influencing circadian entrainment.

Using calcium imaging and whole-cell recordings in acute SCN slices from AVP-IRES-Cre mice, we found that optogenetic activation of ipRGCs elicited diverse responses in AVP neurons, indicating both monosynaptic and polysynaptic connectivity. This previously unrecognized ipRGC–AVP pathway may represent a key mechanism through which environmental light reshapes circadian timing.

Such a mechanism provides new insight into how irregular or excessive light exposure—such as that experienced during jet lag, shift work, or modern nocturnal lighting—may disrupt AVP-mediated circadian output and lead to misalignment between internal and external time. Understanding this pathway could help develop strategies to alleviate circadian rhythm disorders caused by altered light environments.

中文題目：探討 ipRGCs 與 SCN 中 AVP 神經元之間的直接功能性連結

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