Captive pandas could be 'jet lagged' if their body clocks don't match their environment

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All animals have an internal clock called a circadian clock, which is regulated by cues from their environment—but animals in zoos can be exposed to very different cues from animals in the wild.

Since all animals' circadian clocks are linked to their behavior and physiology, this could be significant to their welfare, which is crucial to maintaining captive populations of animals at high risk of extinction in the wild, like giant pandas. Scientists set out to understand how the 'jet lag' of living in latitudes they did not evolve in, and therefore getting cues for their circadian clocks which they are not adapted to, affects pandas.

"Animals, including humans, have evolved rhythms to synchronize their internal environment with the external environment," said Kristine Gandia of the University of Stirling, lead author of the study in *Frontiers in Psychology*. "When internal clocks are not synchronized with external cues like light and temperature, animals experience adverse effects. In humans, this can range from jet lag to metabolic issues and seasonal affective disorder."

Clocking in

Since giant pandas live highly seasonal lives, they are an ideal study species for understanding how the circadian clock affects well-being and behavior. Pandas prefer to eat certain species of bamboo and love new shoots, which triggers a migration as these shoots emerge in spring.

The migratory season is also the breeding season, likely because finding mates is easier when they are all following the same nutritious shoots. Pandas are also so popular that many zoos that house them maintain public webcams, so behavior can be monitored around the clock.

Zoos also provide an opportunity to understand why the circadian clock matters for animal well-being, by moving animals to latitudes outside their normal range where important cues like daylight and temperature ranges will be different. These changed conditions could potentially leave animals 'jet lagged,' especially if their circadian rhythms are very

dependent on seasonality, like pandas. Animals in captivity could also be affected by anthropogenic cues, like keepers' regular visits.

Panda activity in black and white

Gandia and her fellow observers used webcams to monitor 11 giant pandas at six zoos both inside and outside pandas' natural latitudinal range. Every month for 12 months, they carried out a day's worth of hourly focal sampling to gauge how pandas' behavior changed across a day, and how that changed across a year. Thirteen observers took part, noting general activity, sexual behavior, and abnormal behavior.

The scientists found that daylight and temperature were particularly important cues for pandas, closely associated with general activity in latitudes that matched their natural range in China. Captive pandas showed three peaks of activity over 24 hours, including a peak at night, just like their wild counterparts. Adult pandas only displayed sexual behaviors in the daytime, which could make it easier to find mates in the wild.

Pandas outside their home latitude were less active, perhaps because daylight and temperature cues differed at different latitudes. Supporting this, the researchers found that the behavior of the pandas in mismatched latitudes differed from those in matched latitudes most when the pandas in mismatched latitudes were receiving more divergent daylight and temperature cues.

Changing with the seasons

"When giant pandas are housed at higher latitudes—meaning they experience more extreme seasons than they evolved with—this changes their levels of general activity and abnormal behavior," said Gandia.

The researchers also found that all study pandas reacted to zoo-specific cues, becoming very active in the early morning and showing abnormal behaviors that could represent anticipation of keepers visiting with fresh food.

Finally, the pandas' abnormal and sexual behaviors fluctuated at similar points. The researchers suggested this could represent frustration that they can't migrate or mate as normal. Pandas who lived at mismatched latitudes performed fewer abnormal behaviors, possibly because they weren't getting the same cues for sexual behaviors.

"To expand on this research, we would want to incorporate cycles of physiological indicators," said Gandia. "Importantly, we would want to assess sexual hormones to understand the effects the environment may have on the timing of release. This could help us further understand how to promote successful reproduction for a vulnerable species which is notoriously difficult to breed."

More information: Latitudinal and zoo specific zeitgebers influence circadian and circannual rhythmicity of behavior in captive giant pandas (Ailuropoda melanoleuca), *Frontiers in Psychology* (2023). DOI: 10.3389/fpsyg.2023.1188566

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