Indian Society for Chronobiology (InSC)

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Samay

The bi-annual newsletter

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What's Inside

Office Bearers

For Jan 2023 issue, send you entries to

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Editors' note

Happy July 2022!

The 2nd half of the year has begun! As the time is going by, we hope that this year is treating you well and we wish that your future endeavors culminate into favorable outcomes.

We are delighted to share with our readers that the President of our society (InSC), Prof. Vinod Kumar is 2022 recipient of "The Aschoff's Ruler prize". It is one of the highest distinctions in the field of chronobiology. We all feel very proud of this achievement.

We, the editorial team of SAMAY are happy to bring you this issue of our bi-annual newsletter. As we promised the last time that our upcoming newsletters would include at least one trending topic for the Chronobiology community. This issue of SAMAY focuses on "Avian Chronobiology". We have included articles associated with how changes in environment are affecting behaviors and physiology in birds. We have also included a section on "Chronobiology in News" and "Upcoming events".

The credit for successful publication of this newsletter goes to all the members and researchers who contributed to the present issue and helped us fulfill the deadline. We extend our thanks and appreciation to all the contributors who promptly replied to our requests.

As always, drop us a line (inscdu@gmail.com) with your suggestions on topics you'd like to see us cover or things that you like or do not like about what we are doing. We look forward for your feedback and suggestions.

Bhanu Pratap Singh
Editor in chief

Namram S. Singh
Editor

Aakansha Sharma
Editor

From President's desk

Dear Colleagues and friends,

Mid-year greetings and very best wishes for the coming academic session.
I do hope that your time during the first half of the year 2022 has been as good as possible under the prevailing circumstances. And, I sincerely wish you all the best of health, and academic progress in the latter half of the year 2022.

In the last six months, we have been trying consistently to get back to our normal schedules as we used to have during pre-Covid era. In reflection, the pandemic period has been educative to us, in particular in terms of respect to nature, and in finding out ways and means that probably would have long-term impact on our life style, in general, and timing our daily life activities, in particular.

I have some good news to share with you since the time of last ‘Samay’ in January 2022. One is the representation by one of our colleagues in the important meeting of Society for Research in Biological Rhythms (SRBR) held in May in Florida, USA. Dr. Sheeba Vasu attended this meeting as a member of the SRBR Scientific Committee. The second time, the Aschoff’s Ruler Prize has come to an Indian Chronobiologist; the first recipient was Prof. M. K. Chandrashekaran (1991). Two more chronobiology labs will now emerge at the University of Allahabad and University of Lucknow where Dr. Gaurav Majumdar and Dr. Aakansha Sharma have joined, respectively, as the Assistant Professor.

I feel pride that the InSC community has been very active, and is being recognized locally and globally. I look forward to hearing from you about your current and future activities related to Chronobiology. The InSC will support you in all possible ways in conducting an activity for popularizing chronobiology in the country.

My very best wishes to all of you.
Vinod Kumar
President, InSC

Aschoff's Ruler is home again: Congratulations to Prof. Vinod Kumar and Avian Chronobiology in India

Dr. Gaurav Majumdar
Assistant Professor, Department of Zoology, University of Allahabad, UP, India

Prof. Kumar's lab has worked on avian clock systems for decades and established buntings as a model system for studying different aspects of animal migration.

At the recent meeting of the Society for Research on Biological Rhythms (SRBR) 2022, Prof. Vinod Kumar received the highly coveted and most prestigious award in chronobiology research, "The Aschoff's Ruler Prize". In 1991, Prof. M. K. Chandrashekeran, an Indian chronobiologist was the first recipient of this award. He worked on bats as his model species. We all are feeling proud as we congratulate another celebrated Indian chronobiologist, Prof. Vinod Kumar for being the recipient of 2022 Aschoff's Ruler Prize.

Jürgen Aschoff, co-founder of Chronobiology, made fundamental observations about how animals respond to light, that we know today as "Aschoff's Rule". At a dinner held in Aschoff's honor at the Gordon Conference on Chronobiology (1991), Prof. Till Roenneberg, took the battered old wooden ruler which Aschoff used to trace patterns in behavioral data, mounted it on a bronze plaque, and began the tradition of giving Aschoff's Ruler to a top scientist in the field working on an organism different from the one of the current holder of the prize.

Prof. Kumar attained his doctoral degree studying avian biological rhythms from Department of Zoology, Banaras Hindu University in 1981. Since then, he has established world class research labs in Chaudhary Charan Singh University, Meerut, University of Lucknow, and in University of Delhi from where he retired as a Senior Professor in 2020. He has published more than 200 research articles which includes original research articles, book chapters and reviews on multiple aspects of

circadian and seasonal adaptation using birds as the model system. He also has three books edited/authored on the topic. He is the recipient of numerous national and international honours which includes Young Scientist Award from Indian Science Congress Association and have served in the editorial board of many international journals. Beyond research Prof. Kumar initiated the SERC/SERB school series in Chronobiology which has been a flagship activity of chronobiology research in India. The 13 school series invited a large number of international faculty to visit India and collaborate with different labs putting Indian chronobiology on the map of the world. The research focus of Prof. Kumar's lab is in understanding avian circadian and seasonal physiology employing studies ranging from behavior to molecules. His lab did pioneering work in implicating the role of daily and seasonal clock system in the regulation of avian migration establishing migratory buntings as a perfect reproducible model system to study the complexity of avian migration up to the molecular level. The lab also utilized birds to study long term circannual rhythms which have gained much interest in recent years. Prof. Kumar was recently elected as Fellow of Indian National Science Academy (FNA) and currently serves as UGC-BSR Faculty Fellow and the President of Indian Society for Chronobiology.

The award is a fitting tribute to a long research career on an unorthodox class of animal and it will indeed be a great moment for Indian chronobiology to see Prof. Kumar's name engraved at the back of the Plaque as the tradition goes.

Vinod Kumar
Aschoff's Ruler Recipient, 2022
Birds
India

Light, Melatonin and Cognition in Birds

Dr. Amaan Buniyaadi
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Birds are considered as one of the most successful organisms, given that they are extremely adaptable, and exhibit remarkable flexibility both in their behaviour and physiology. Among many other factors that make them so efficient, their sociality and intelligence are considered the most important. Whether it is the intelligence of 'the thirsty crow' or the neural plasticity of the avian brain during long arduous, challenging migratory journeys, birds have outperformed almost all other taxa, when it comes to intelligence. Much like mammals, the representatives of the corvidae family and order Psittaciformes, exhibit highly advanced cognitive feats such as innovative problem solving, learning and memory efficiency, tool use, mental time travel, and theory of mind and metacognition as well. The avian brain is essentially both structurally and functionally analogous to the mammalian brain, and owing to its highly developed neocortex, it can perform very effectively in cognitively challenging scenarios and environmental conditions. The environment around the birds essentially plays an extremely important role in regulating their neural functioning, thereby controlling their behaviour as well. Birds entrain their behaviour and physiology to the prevailing light environment. Both diurnal and nocturnal birds rely on photoperiodic cues for daily circadian functions such as foraging, singing, roosting, and reproduction. Hence, any disturbance in this light environment will eventually alter these daily functions. Due to prevailing light pollution (or dim light at night), birds exhibit marked alteration in the above-said behaviours. The most profound effect of light pollution is the disruption of daily melatonin rhythms. Melatonin is a neuro-hormone secreted by the pineal gland during the night. Since pineal is photoreceptive, its exposure to light at night leads to suppression of melatonin synthesis and release in many birds such as house crow, zebra finches, black birds, great tits and tree sparrows.

Melatonin is also an important hormone in the regulation of sleep and other brain function. Its role has been studied in neurogenesis, synaptogenesis, maturation of neurons, and cognition as well. Recent studies have shown that under no night environment which suppresses melatonin synthesis significantly, zebra finches exhibit circadian disruption with learning and memory deficits in colour association, spatial learning and song learning as well. House crows exhibit depressive-like functions along with lower exploration of novelty

suggesting lower motivation. The neuroprotective and neuro-modulatory function of melatonin when tested in house crows under dim light at night environment suggests a positive effect on cognitive performance. Exogenous administration of melatonin to crows in a light at night environment has an ameliorative effect on cognitive deficits. The crows exhibit better problem-solving efficiency and enhanced spatial-pattern learning and memory retention. This positive effect was also evident at the brain molecular level. The negative impact of light at night on the expression level of genes associated with neurogenesis, synaptic plasticity and dopamine biosynthesis and signalling was completely alleviated by the melatonin administration, thus enhancing the cognition of the crows. Thus, maintenance of normal nocturnal melatonin levels can be crucial under an ALAN environment, which is a growing pollution threat in an ever-changing environment to animals, and perhaps also to humans.

Are zebras of the avian world a good cognitive model? Testing multiple cognitive tasks in zebra finches

Ashwani Kumar
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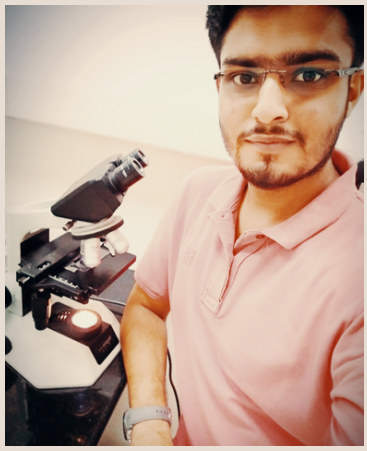

Zebra finches have long been a valuable model organism for addressing questions about reproduction, mate choice, song production and neurobiology. These make the zebra finch an excellent model for investigating cognition. The lab breeding capacity and survival in almost every condition also make them possible to test more complex cognitive abilities, such as the ability to remember what happened where and when and, as they are social animals and live in flocks, their social memory (e.g., remembering which individual did or saw what) and social cognition (e.g. keeping track of what another individual has and has not seen and does and does not know), extending the work traditionally conducted on primates or corvids. In a pilot experiment, we tested male and female zebra finches in various reward-based cognitive tasks. More birds participated (60-65%) than non-participants (35-40%) in almost all the trials. For general cognitive tasks, we food-deprived birds for 15 hours to motivate them to perform colour or pattern or spatial learning and memory, innovative problem solving via lid manipulation and tunnel drawer task. We found that finches were able to memories colours (62.5%), patterns (50%) and positions (58.8%) of rewarded lids when presented with six choices in each trial. Interestingly after one and 24-hour memory retention, we tested these birds for extinction

learning, in which bird has to forget what is been memorized yet and then learn something novel in terms to fetch reward. Almost 70% of the birds from both the innovative problem-solving task completed the task. There was no effect of sex in any of the tasks. We argue that zebra finches are highly cognitive as other avian model species like parrots, pigeons and corvids. Even with smaller size, high social behaviour, low cranial capacity and exploratory behaviour in the wild, the zebra finch can be a very useful model system for higher cognitive behaviour as it can reproduce in the laboratory condition and is highly social in nature.

Anthropogenic pollutants and birds

Khushboo Chaturvedi
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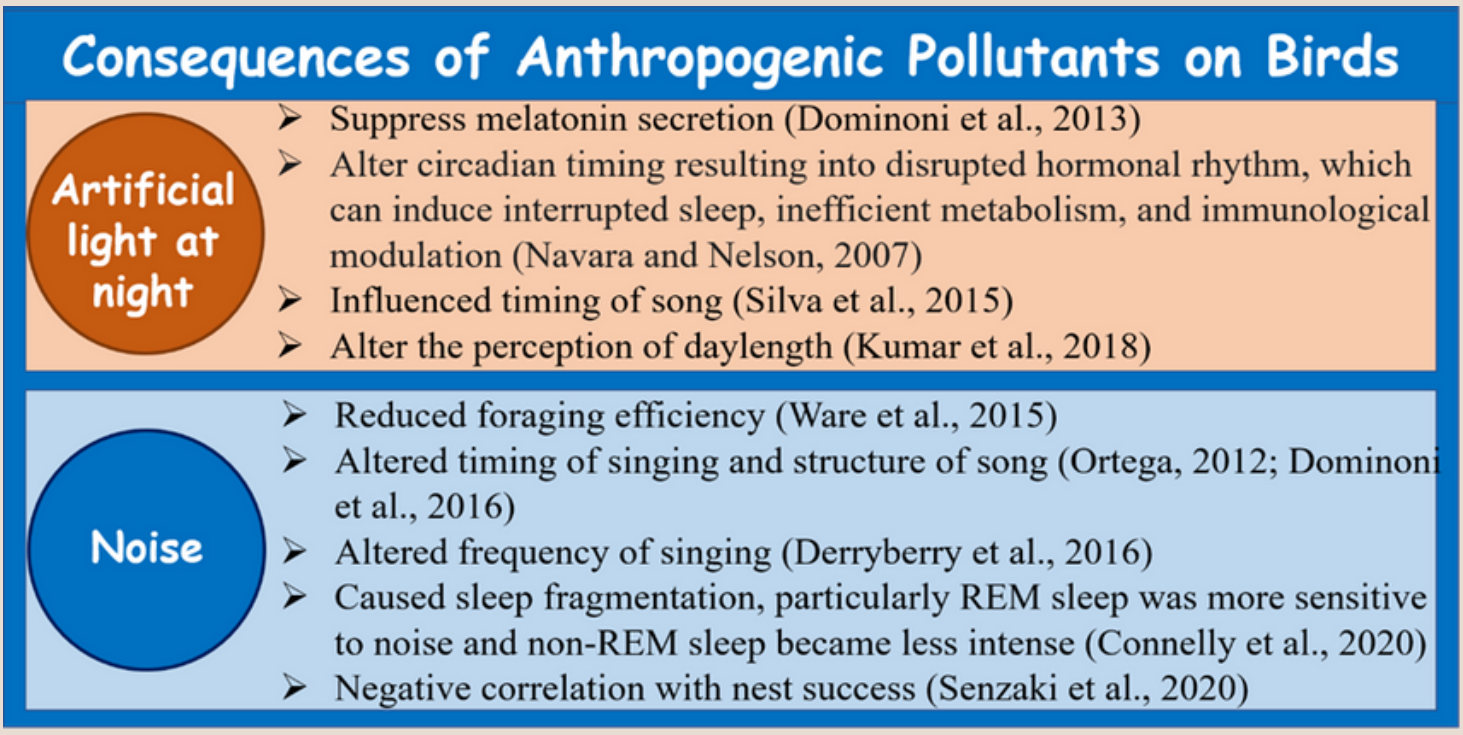
For birds, urbanized habitats are remarkably different from natural habitats particularly in terms of anthropogenic disturbances which are continuously increasing with the growth in human population. Sensory pollutants such as noise and artificial light at night (LAN) co-exist in urbanised areas (Dominoni et al., 2020) and cause harmful effects on wildlife. Survival in such an altered habitat from the natural course forces birds either to accept the change with pronounced phenotypic differences in behavior, physiology and morphology, or to avoid it, since these factors pose novel evolutionary challenges which

may signify robust stressors influencing the ecology and evolution of organisms (Swaddle et al., 2015). Compound effect of these pollutants on urban birds revealed that nocturnal activity was synergistically affected but the diurnal activity was antagonistically affected in great tits. In another study conducted on forest birds, traffic noise attracted the vocalizing birds (Henniger et al., 2019). According to Willems et al. (2022), these anthropogenic pollutants can affect the taxonomic richness and composition of the communities. However, they also observed that LAN alleviated the harmful effect of noise on the overall species richness. In North American birds (140 species), the interaction of these pollutants resulted into negative responses for several species (Wilson et al., 2021). Long-term consequences of noise-induced sleep restriction and sleep fragmentation needs more research for validation; however, widespread and disruptive impacts of urban noise on sleep composition, architecture, and intensity have been reported in magpies (Connelly et al., 2020). Da Silva et al. (2014) found that LAN, but not noise, primed an earlier onset of dawn singing in 5/6 species.

Till date, studies that have examined the effects of co-exposure of noise and LAN on avian reproductive success are however, very sparse (but see Ferraro et al., 2020). In the current scenario, more research is needed to be done to test if co-exposure of wildlife to these sensory pollutants is more deleterious than considered, and if so, then taking the necessary actions at global scale particularly in urban areas, is the need of the hour, since urbanization is expanding at a dramatic rate.



Effects of Food Availability on Immune Response in birds

Abhishek Kumar
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Availability of food, food quality, incorporation of food supplementation and different feeding regime may result in different energy demand thereby influencing the overall health in birds. One would expect that food restriction (FR) may lead to variation in avian and mammalian health status. The birds having constant, and predictable food resource are expected to be in better health condition as compared to birds with low food availability. Only few studies explored the impact of food provisioning on immunity in wild bird species and they are only limited to availability of food resource rather than comparing specific ingredient. Therefore, most studies assessing the impact of food provisioning on wildlife immunity have been carried out in captivity. During food restriction (FR), animals are fed a proportion of their daily energy requirements in order to assess the level of deprivation at which immunological function can be maintained. Research on the effects of FR on innate immunity in wildlife has been limited. Such experiments are limited to very controlled settings where food intake can be closely regulated. As has been reported by Merlo et al., 2016 and Schleich et al., 2015, Tuco-tucos (*Ctenomy stalarum*) lost body mass by 10-25%, increasing their neutrophil/lymphocyte, N:L ratio (indicating stress) under restricted food regime, but not their microbial killing assays; or natural antibodies. Studies in captive birds such as Curve-billed thrashers (*Toxostoma curvirostre*) and hooded crows (*Corvus cornix*), that compared stable (predictable) to variable (unpredictable) feeding regimes, revealed that neither species showed any difference in Heterophil and lymphocyte ratio (H:L, a stress marker) despite reduced body mass for the thrashers on the variable diet, and elevated levels of the stress hormone corticosterone.

By testing ex vivo lymphocyte proliferative responses to lectins in cotton rats (*Sigmodon hispidus*), Lochmiller et al. 1993, found that moderate FR (80% of *ad libitum*) enhanced adaptive immunity, whereas severe FR (80% of *ad libitum* followed by 40%) inhibited it. Another study by measuring delayed type hypersensitivity (DTH) revealed that severe FR further weakened T cell immunity (but moderate FR was not examined). Similarly, Xu and Wang, 2010 showed that fasting in Mongolian gerbils (*Meriones unguiculatus*) exhibited a lower response to DTH .

In addition to this, several studies has also found reduced T cell immune response in bird species such as including yellow-legged gull (*Larus michahellis*), sand martin nestlings (*Riparia riparia*) and little ringed plovers (*Charadrius dubius*). In contrast, Eberhardt 2013 studied capybaras (*Hydrochoerus hydrochaeris*) and found that FR (40–50% reduced intake) increased innate immunity components (nAbs and eosinophil levels). Similarly, microbial killing assays were positively correlated with fat deposits in FR Siberian hamsters (*Phodopus sungorus*), while no effect was seen on those receiving *ad libitum* food.

It can be concluded that under unfavorable conditions, such as low food availability, at least immunity can increase transiently, while long-term or more severe food restriction can result in reduced immune response owing to energetic demand.

Disrupted environment and reproduction in birds

Nidhi Yadav
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Under the natural environment, reproduction in the bird is mainly shaped by the proximate (e.g., light and temperature) and ultimate factors (e.g., food and mate). But with increasing urbanization, almost all the human-inhabited areas have illuminated nights. The artificial light at night (ALAN) causes disruption in the endocrine system that can alter various physiological outputs including immunity, sleep and reproduction. Studies have shown the effects of LAN on reproduction like advanced testosterone level, early moulting and one-month advance in reproductive system development in European blackbirds and an increase in levels of testosterone, estradiol and Luteinizing hormone (LH) in Florida scrub-jay (*Aphelcoma californa*). Another study showed that European blackbird advances their date of clutch initiation by 6 days per lux and daily nest survival rates also increased with increasing LAN. These early findings suggested that LAN plays a major role in inducing changes in breeding physiology. Like blackbirds and scrub jays, exposure to artificial light at night resulted in the advancement of LH secretion but with lowered peak. In fact, the changes in nesting behaviour in chicks and the number of eggs laid in great tits and clutch initiation have also been observed due to exposure to LAN. All these studies indicate the role of LAN in altering reproductive output, behaviour and physiology.

Interestingly, most of the studies related to LAN were performed on photoperiodic birds, hence, the daily and overall seasonal effect cannot be deciphered unless a clear comparison of the effect of LAN with the non-photoperiodic opportunistic species is addressed.

Recently a study from the University of Delhi highlighted the importance of dark nights on zebra finch (Taeniopygia guttata), a non-photoperiodic diurnal species, this study showed the decline in singing quality, learning and memory, offspring number and their quality due to constant light environment. Constant light has been shown to affect the circadian clock in both mammals and birds. We know from multiple studies that low intensity (5-10 lux) of dim light at night affects general physiology, metabolism, and cognition in zebra finches and Indian house crows (Corvus splendens). Hence, more studies are needed on these avian species to decipher and elucidate the deleterious, if any, effects of the illuminated night on the overall reproductive quality. Based on these we might infer the beneficial effect of lighting on overall human growth with the possible negative consequences to both humans and other animal species inhabiting the same habitat.

Light at night affects overall metabolic machinery in diurnal zebra finches

Mayank Kumar
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Illuminated night has been shown to affect sleep, body mass and general physiology in avian species. However, its effect on genes regulating DNA methylation and histone acetylation with correlation to fat regulation is not well understood. We kept the adult male zebra finches in dim light at night (LAN= 5 lux) with controls on dark nights for 6 weeks with food and water *ad libitum*. Light at night increased nighttime feeding, induced fattening and hence body mass in birds under LAN conditions. We measured the mRNA expression of genes regulating epigenetic modifications (*hat1*, *hdac3*, *hdac4*, *dnmt3a*, *tet1* and *tet2*) in liver and those associated with fat and glucose metabolism (*sirt1*, *ppar alpha* and *fat/cd36*) in the liver, muscle and hypothalamus. LAN increased *hat1* and *tet1* gene expression in the liver compared to light dark condition (LD).

Also, *ppar alpha* (lipogenesis inducing) and *cd36/fat* (fatty acid transporter) gene expression were significantly higher in both the liver and hypothalamus suggesting an increase in fat metabolism in the liver and fat sensing in the hypothalamus. This is directly correlated with the fattening in zebra finch exposed to light at night as compared to LD. The muscle gene expression also showed decreased *sirt1* and increased *cd36* similar to other areas. Insights from these results show the possible alteration in the overall metabolic state of birds exposed to light at night.

TH-responsive pathway: Evidence of a conserved mechanism for thermal induction

Dr. Sayantan Sur
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The annual changes in the abiotic environmental factors confine the availability of natural resources to particular times of the year. Thus, small windows of favorable conditions are present in a year, which are optimal for high-energy life events. Naturally, to utilize these brief windows, organisms have developed endogenous mechanisms to sense the changes in the environment. It has been long known that seasonal animals detect the changes in photoperiod, arguably the most robust cue to prepare for their respective seasonal events. However, the underlying mechanism remained obscure until Nakao et. al 2008 discovered the TH-responsive pathway in Japanese quails, which start from the transcription of *tshb* in pars tuberalis to the synthesis of bioactive T3, which causes the secretion of GnRH. This pathway was found to be conserved across taxa in seasonal animals. Changes in day length are also coupled with changes in the ambient temperature, so it is plausible that thermal cues can also influence the TH-responsive genes. This was tested in European eel (*Anguilla anguilla*), where temperature induced changes in the expression of TH-receptor, and deiodinases in early life history stages (Politis et al. 2018). This was followed by a study in 2019 on redheaded buntings (*Emberiza bruniceps*) by Trivedi et al., who found temperature-dependent changes in the hypothalamic mRNA expression of *tshb*, *dio2*, and *gnrh* genes.

This suggested that ambient temperature fine-tunes the photo-induction of TH-responsive genes, which consequentially affect the gonadal development. This theory was further supported by Rosmalen et al. (2021), where the expression of dio2 and dio3 genes in common voles (*Microtus arvalis*) was modulated by summer and winter temperatures. It is phenomenal that across different classes of vertebrates this mechanism seems to be conserved, and as light and temperature are intertwined in nature, so are the underlying machinery involved in their perception. Further studies need to be performed to understand if temperature-modulated photoinduction also involves epigenetic modifications of histones and genes.

Cognition in birds

Vaibhav Vaish
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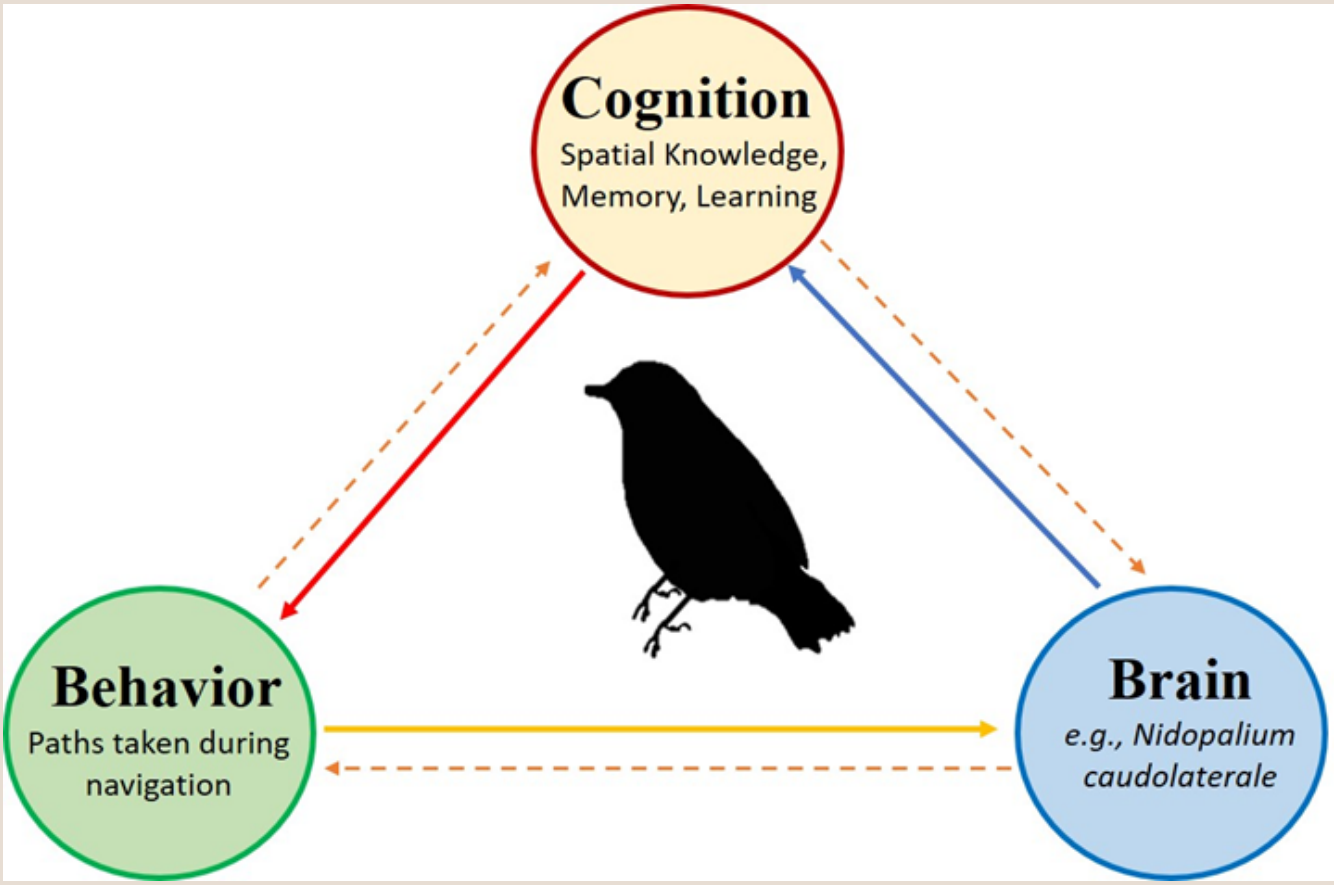
Everybody is aware of the renowned fable of the thirsty crow who puts stones in an earthen pot containing water at its bottom, in order to quench his thirst when the water level rises. Birds are an excellent model for studying associative learning which has been proved through several experiments (Taufique and kumar 2016; Buniyadi et al., 2020; Prabhat et al., 2022). In spite of having substantial differences in the neural architecture, corvids and parrots have comparable cognitive ability to apes and other large-brained mammals (Güntürkün et al., 2021) due to convergent evolution (Shimizu & Watanabe, 2012).

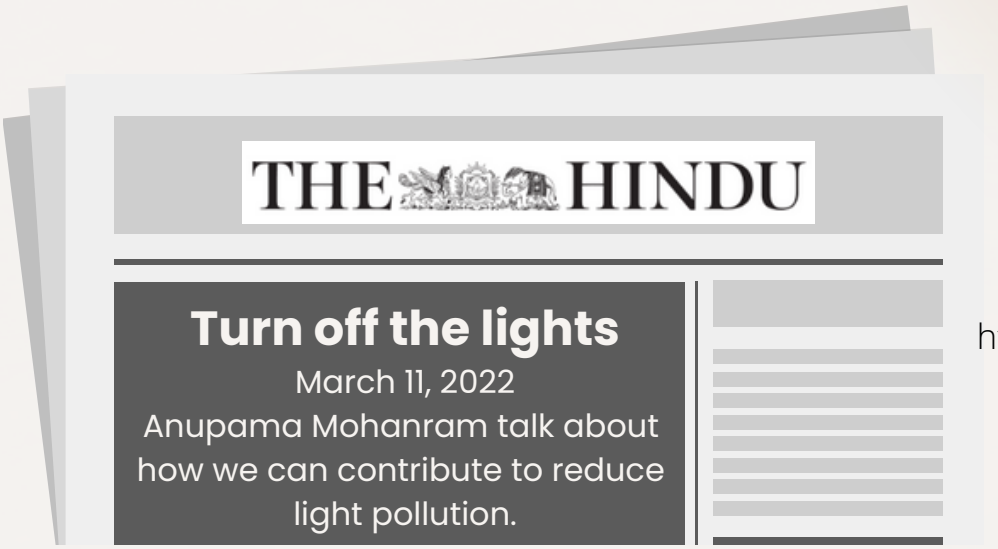
Their cognitive ability comprises of casual reasoning, behavioural flexibility, imagination, and prospection (Baciadonna et al., 2020). Corvids and parrots possess superior intelligence among other birds. During the long development period, they live in complex flocks before becoming independent and display ape-like intelligence. Sensory systems such as visual, auditory and even motor system show strong resemblance between mammals and birds.

In avian brain, the lateral and ventral regions of the pallium are crucially involved in regulating cognition (Emery, 2016), however, complex cognition is supported by brain region nidopallium caudolaterale (NCL), which is functional equivalent of prefrontal cortex (PFC) in mammals (Güntürkün and Bugnyar, 2016). Densely packed neurons have been observed in the pallial telencephalon (forebrain) of the corvids and parrots which is indicative of more brain capacity per unit area than some mammals (Olkowicz et al., 2016). Avian cognition studies have two different approaches namely the 'anthropocentric approach' and the 'adaptive specialization approach' but the most consistent approach is considered to be the combination of these two approaches (Emery, 2006).

Studies have found that brain in corvids is equipped with advanced cognitive abilities since they are able to make, use and innovate tools (Cheke et al., 2011; Kabadayi & Osvath, 2017). Besides corvids, grey parrots and cockatoos have been found to use tool such as stick to scratch their body or use a nut's shell to collect water from the bowl (Boswall, 1977). The driving force behind the evolution of tools' usage is considered to be the interaction among overt behavior, learning, and surrounding environment (Amodio et al., 2018). The figure shown below is adapted from Huffman and Ekstrom (2020) which shows the interrelation between brain, behavior and cognition.



CHRONOBIOLOGY IN NEWS



Read full article at:
https://www.thehindu.com/real-estate/turn-off-the-lights/article65208647.ece

Chronobiology
Timing is Everything®

New Research Pinpoints the Best Time to Exercise for Men and Women

June 22, 2022

According to a new study by researchers from Skidmore College, Arizona State University and California State University, the time of day can impact the outcome of exercise.
This new research also revealed that the best time to exercise for men and women may differ.

Read full article at:
https://www.chronobiology.com/new-research-pinpoints-the-best-time-to-exercise-for-men-and-women/

What to Do When You Can't Sleep

June 15, 2022

Not being able to sleep in proper time is a major issue and can become very stressful, especially when one has to get up at fixed time for school or work on the following day. This article talks about what can be done to sleep better.

Read full article at:
https://www.chronobiology.com/what-to-do-when-you-cant-sleep/

Upcoming events

EUROPEAN BIOLOGICAL RHYTHMS SOCIETY-2022 CONFERENCE

July 24-28, 2022, Zurich

For details: www.ebrs2022.uzh.ch

4TH ANNUAL MEETING OF ASSOCIATION OF AVIAN BIOLOGISTS IN INDIA (AABI)

&

NATIONAL SYMPOSIUM ON AVIAN BIOLOGY

November 9-11, 2022, Gaya, Bihar

Share your feedbacks

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Become a life member of Indian Society for Chronobiology

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