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Synchronising Genetic Body Clocks To Circadian Rhythms And Ultradian Rhythms For Obtaining Highest Performance In Life Using Wearable Technology

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Abstract - In 2017 3 scientists (Jeffrey C. Hall, Michael Rosbash, Michael W. Young) received Nobel prize for their research in medicine and physiology, Their research proved the existence of multiple biological genetic clocks throughout the body and among them one “Master Body Clock - suprachiasmatic nucleus (SCN)” which sits in the brain (for humans) synchronizing all other body clocks. There are many kinds of daily revealed rhythms which are “Measurable” and “Observable” The multiple body clocks within humans and other animals of the animal kingdom are underpinned by these biological clocks which produce certain behavioral pattern mainly associated with “Finding Food,” “Finding Mates” and “Avoiding Predators” along with many aspects of physiology. The most prominent rhythms are “Circadian Rhythms” and

“Ultradian Rhythms” with the help of wearable technology we can measure the activity of our body organs which have these body clocks and with extensive data visualization and or with machine learning capabilities we can provide more information as to how we can optimize our days with these rhythms to squeeze the most performance out of the day to attain peak performance and results in many aspects of life.

Keywords: Circadian Rhythms, Ultradian Rhythms, Genetic Body Clocks, Wearable Technology, Life Science

1. Introduction

In 2017 a Nobel prize was awarded to three scientists Jeffrey C. Hall, Michael Rosbash,

Michael W. Young for research that proved the existence of multiple biological genetic clocks throughout the body initially these experiments were conducted on *Drosophila melanogaster* (commonly referred to as fruit fly). These biological clocks govern the functioning of our body organs as to how they should perform during day or night to support functions of the physiology of the particular organism later when tracking these genetic clocks in other animals it was found that all of the members of the animal kingdom have these body clocks including us humans.

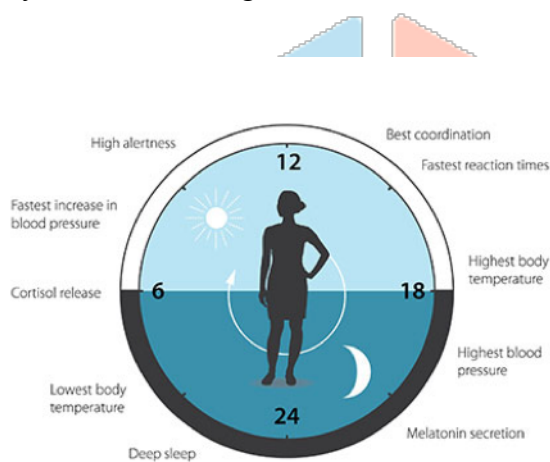


Figure 1. The Circadian Clock Anticipates and adapts our physiology to the different phases of the day. [1]

Every aspect of our physiology is affected by the operations of these biological clocks, If we want to be the best versions of ourselves and obtain peak performance in sports science art etc. we must optimize our days to these rhythms for which we are biologically wired, We not only can improve our performance in fields of interest but also we can optimize our days to attain and keep our health in the best possible state by controlling and scheduling food intake medicine intake and

nutrition intake as to make gain best possible results from them.

2. Circadian Rhythms:

It has been proved that organisms adapt their behavior to 24 Hour day-night cycles. Circadian rhythms are very easy to measure and observe these rhythms occur due to the sunrise and sunset cycle. The circadian rhythm certainly evolved because of the illumination by the sun due to the rotation of the earth in the 24-hour cycle. In 18th-century French astronomer, Jean-Jacques d'Ortous de Mairan demonstrated the existence of internal body clock through experiments on mimosa plant which is known to open and close its leaves at sunrise and sunset respectively even when the plant is kept in absolute darkness. Jeffrey Hall and Michael Rosbash identified a gene called Period (PER). They observed that PER protein levels oscillated with a 24-hour rhythm.

In humans, we have one master body clock among many which sit in our brain and is called the suprachiasmatic nucleus (SCN). The operation of the SCN involves the human visual system when the sunlight or light hits the eyes even with closed eyelids those light signals are then transferred to the SCN and secretion of Cortisol occur which is also known as the waking neuromodulator (a hormone). Secretion of Cortisol serves two purposes one is the signal to all the body clocks that it is day time and to synchronize and perform the operations which are supposed to be performed during day time and a second purpose is a trigger to release another neuromodulator called melatonin which is also known as the sleep hormone. When the sunset occurs secretion of melatonin happens which also serves two purposes first is to send a

signal to all the body clocks that it is a night cycle and to synchronize and perform operations that are supposed to be performed during nighttime.

In order for all the body clocks to synchronize to the sunrise and sunset cycle they need light information thus in humans we have specific cells in our retinas which are called “photosensitive ganglion cells” these photosensitive ganglion cells get activated during particular times of the day when the sun is at a low solar angle that is sunrise and sunset by the low-frequency light (the purplish tint with the spread of yellowish light) and each day this cycle continues and Nocturnal and Diurnal members of the animal kingdom synchronize themselves particularly for 3 activities “Finding Food,” “Finding Mates” and “Avoiding Predators” along with many aspects of physiology.

3. Ultradian Rhythms :

Ultradian rhythms in chronobiology are known as rhythms that repeat throughout 24-hour cycles. The ultradian rhythms for a human being are 90 min cycles this in 24 hours we have 16 ultradian cycles throughout the day for the purpose of elaboration of ultradian rhythms consider the example of sleep under normal conditions humans sleep in 4 stages, Stage 1,2,3 being non REM Sleep (Rapid Eye Movement) and stage 4 sleep which is REM Sleep (Rapid Eye Movement Sleep) these stages are lighter do deeper from stage 1 to stage 4 in this example of sleep REM sleep is crucial for recovery from days work that brain and body does, Similarly, all the other organs related to our physiology show similar facsimile of a pattern of behavior where a certain portion of the 90-minute cycle is optimal for getting most of the performance.

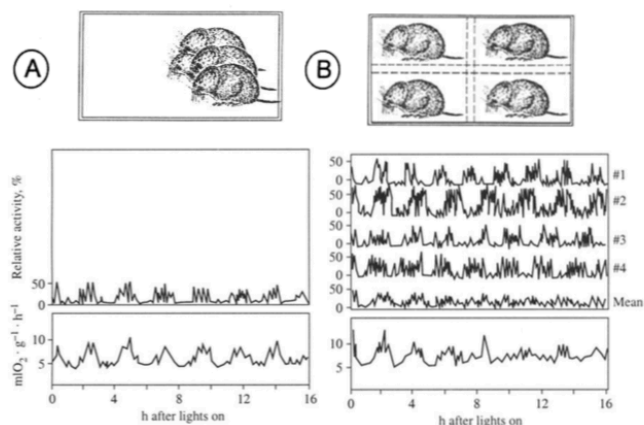


Figure 2. Patterns of activity (passive infrared detection) and oxygen consumption during daytime in the common vole (*Microtus arvalis*), in a light:dark cycle of 16:8 hours, at IODE. Panels A: measurements of four voles kept together. Panels B: measurements of the same four voles, separated by wire mesh. Activity is expressed as percentage of time with activity, per 2 minutes. In the separated condition, individual voles kept their individual rhythms, but note the decay in synchrony in the course of the day. [8]

4. Significance Of Circadian Rhythms And Ultradian Rhythms

Circadian and Ultradian Rhythms govern our physiological behavior and are observable at different levels

4.1. Mimosa Plant Experiment

In 18th-century French astronomer, Jean-Jacques d’Ortous de Mairan demonstrated the existence of an internal body clock through experiments on mimosa plants.

This experiment proved that the existence of genetic body clocks in the other members of the animal kingdom other than us by showing that the mimosa plant continues to behave in a similar way

when put in complete darkness due to the biological clock and that clock being underpinned by the ultradian rhythms

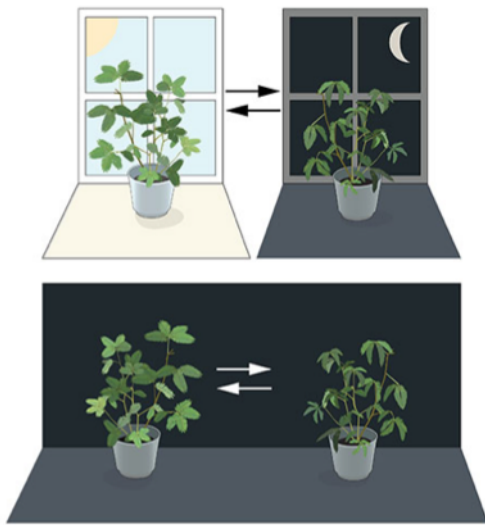


Figure 3. An internal biological clock, The leaves of the mimosa plant open towards the sun during day but close at dusk. [1]

5. Wearable Technology To Measure Health And Synchronise Ultradian And Circadian Rhythms

We have technologies readily available which can measure the activity of our internal organs and much more with accuracy throughout the 24-hour circadian cycle and give us accurate knowledge of how our ultradian rhythms are synchronized with the circadian rhythms, with using devices like constant glucose monitor we can measure glucose activity of a person throughout 24 hours and figure out the ultradian working cycle of the associated organ or physiological part similarly there are different devices are available which could give us popery of accurate information and we can build a profile as to how the internal body clocks are performing as per the ultradian and circadian cycles. It is very important information and crucial if the goal is optimizing health or

performance in a field of sports or other areas of interest, This accumulated data with wearable devices with the use of machine learning algorithms can give us an edge as to how we can treat certain diseases better or how we can take better care by optimizing food intake, medicine or nutrition intake, the time of day when we should exercise, Rest, for which we are biologically built with these biological clocks to get most out of life.

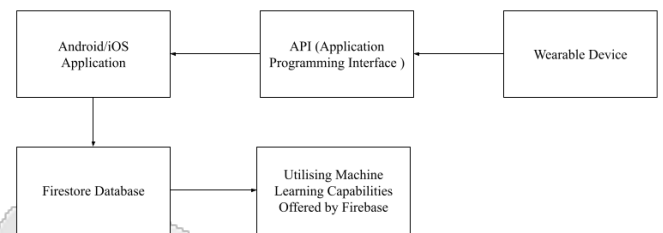


Figure 4. System To Synchronise Circadian and Ultradian Rhythms With Wearable Technologies.

6. Conclusion :

It is conspicuously obvious from the findings in the papers for which the scientists received Nobel prize that our life is governed by the Circadian and Ultradian rhythms which are underpinned by these biological clocks in all aspects of our being and physiology, It is ideal that we optimize our lives to squeeze out most from the day by synchronizing ourselves with the circadian and ultradian rhythms which are very possible by readily available wearable technology. Which gives an enormous edge to our day-to-day life in many ways.

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