How the Body Creates Rhythms

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How do cells and biological systems perceive time? To perceive time, a clock is needed; clocks are rhythms like the rhythms of the sun and moon from where we have created our chronological time. All clocks, from the lifespan of a human to the process inside a cell, have an internal clockwork that, throughout life, responds, regulates, and communicates our life process.

A rhythm is a wave moving in time, and a wave is an oscillation, so the creator of a rhythm is an oscillator. As described above, autonomous rhythms such as the heart rate and respiratory breathing use oscillation at the single cell level that are united to form groups of cells that can oscillate a rhythm, often in a central organizing place of the body as the heart and the brainstem.
The circadian rhythm is a central master rhythm located in one of our body's most central organizing centers, the hypothalamus. The hypothalamus "sits" on the midline of the sphenoid bone above the sella turcica, the deepening of the sphenoid bone holding space for the pituitary gland. In the hypothalamus, a bilateral cluster at the left and right side of the third ventricle called the suprachiasmatic nucleus contains around 20,000 nerve cells with coordinated rhythmic excitability creating the circadian rhythm. A group of oscillating neurons are sensitive to light and fine-tune the rhythm of the day/night cycle, including seasonal changes in the light period.

What creates and coordinates the rhythmic excitability of the neuron? The creation of the oscillation takes place on the molecular level at the fundament for life, *the central dogma* of biology, that states that the template for life DNA is transcribed into RNA that is translated into protein. The oscillation is created by a transcriptional and translational feedback loop. The neuronal oscillation created by the feedback loop expresses a gene on the DNA level; the resulting protein changes the excitability of the neuron, and the protein blocks its own gene expression and initiates its own degradation. As the protein is degraded, the block of the gene expression is removed, and a new cycle occurs.

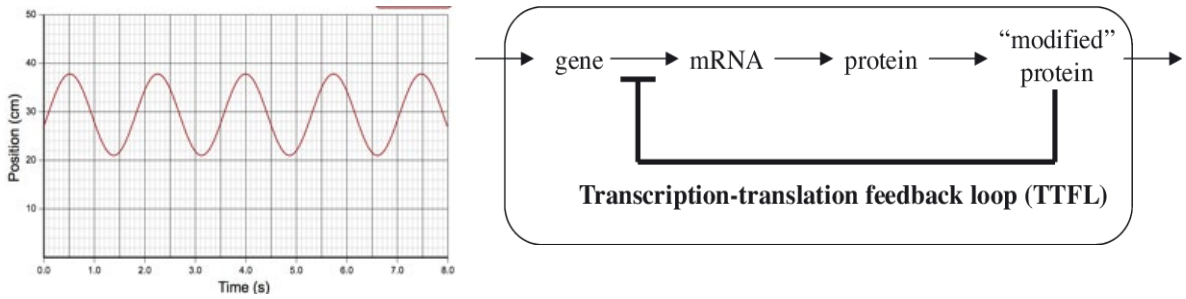

Figure 8. Left oscillation from neurons. Transcription-translation feedback loop.

Harmonics, Communication, and Physiology

Rhythms may be related in harmonics as a series of natural frequencies that can be identified as subdivisions or master communication systems for the body. When an oscillator creates a rhythm in the body, it may result in a series of natural rhythms. A natural rhythm is where a standing wave pattern is created and is called a harmonic frequency. At all other frequencies, the wave pattern from the oscillator is irregular and non-repeating. The original wave produced by the oscillator is called the 1st harmonic or the fundamental frequency. The following standing wave can be created at one-half the wavelength of the first harmonic, the third harmonic is one-third the wavelength of the first harmonic, and so on. The frequency of the rhythm is related by whole number ratios, between first and second harmonic 2:1, second and third 3:2, and so on. Each oscillator can thus generate a set of natural frequencies with a standing wave pattern. All waves in a

harmonic system travel with the same speed, as the rate only depends on the media the wave travels in, here, our body. So, palpating rhythms from the same harmonic series will all have the same speed but different frequencies.

Cells in our body have different rhythms; as described above, the circadian 24-hour cycle involves a prominent cycling rhythm in gene expression. In addition, cells show 12-hour, 8-hour, and 4-hour rhythms, the second, third, and sixth subharmonic of the circadian rhythm. The 12-hour cycle is also the rhythm of the lunar cycle, and the circadian and lunar seems to communicate as two master rhythms of the body. For example, the 12-hour cycle is seen in the gene expression of liver cells giving a 12-hour activity cycling. In Chinese medicine, a classical experiential concept is the organ clock with a high and low energy peak at 12-hour high and down in a 24-hour cycle, now supported by modern experimental science with the 12-hour gene expression cycling in organs. The rhythmic process of cells and cell organelles are coordinated, so that cell division and metabolism are coordinated by master clocks of circadian and diurnal rhythmic systems. In evolution, our life-giving rhythms have been developed by the rhythm of the sun and moon using the fundamental *central dogma* architecture of rhythms.

Synchrony, coherence, and homeostasis. Homeostasis is a state of steady physiological equilibrium, essential for maintenance and adaptation to life. Homeostasis is based on the coordinated balance among tissues and organs to ensure systemic control of physiology.
Life and physiology have evolved as the Earth rotates around its axis, establishing light-dark as a perpetual cycle. Our homeostasis and health are connected to the coherence of natural rhythms.
In this context, the rhythms form the necessary communication using entrainment, phase-locking, and coherence in the hierarchy network of rhythms. The circadian and lunar rhythms represent the quintessential examples of homeostatic control. Homeostatic failure is the basis of many diseases, and rhythm malfunctioning as loss of circadian and lunar coherence often imposed in modern society disrupts coordination among rhythms. It has been linked to various diseases, such as cardiovascular disorders, metabolic perturbations, neurological disorders, and increased cancer risk. Thus, uncovering the physiological circuits whereby biological rhythms achieve coherence will inform challenges and opportunities in human health.