

# Human aging and evolution: The essentiality of life instability

*Ni Putu Wulan Purnama Sari*

Faculty of Nursing, Widya Mandala Surabaya Catholic University, East Java, Indonesia

July 12, 2024

“Because his catch has been so unstable, Kingfisher does some thinking. Then some scheming”

–In ‘Joint Venture’; [The Kingfisher Story Collection](#).

## [SCIENCE COMMUNICATION]

In 1877, Joel Asaph Allen, an American zoologist, mammalogist, and ornithologist, proposed Allen’s rule, an ecogeographical principle stating that homeothermic animals have a specific ratio of surface area to volume that is associated with their habitat’s average temperature [1]. This rule explains why animals in cold climates have shorter, thicker limbs compared to those in warm climates. However, scientists pointed to exceptions like the short-legged bush dogs in Central and South America and widespread species such as common frogs, suggesting that not all animals conform to this rule.

In May 2024, John Tower, a molecular biologist from the University of Southern California, proposed a new biological law of universality stating that life requires at least some level of instability. He introduced the concept of selectively advantageous instability (SAI), which highlights the benefits of life’s inherent instability. SAI increases the complexity of systems, aiding in adjustment and adaptation across all biological levels [2]. Tower’s theory challenges the traditional view that biological systems prioritize the conservation of resources. Without instability and its accompanying downsides, life would struggle to adapt to changing environments, ultimately leading to death and extinction [3].

This presents a contradiction in life: the need for stability to conserve resources versus the need for instability to facilitate adaptation. What are the implications for human aging and evolution?



**Illustration:** Generated by Windows Copilot.

Humans, as complex multicellular organisms, undergo both degradation and development through processes like apoptosis (programmed cell death) and mitosis (cell division). In the context of human aging and evolution, the importance of SAI is evident in the minimal gene set required for a viable human cell. The SAI principle supports energy generation crucial for activating degradation processes in cells. Signaling factors and short-lived transcription facilitate prompt responses to environmental changes, and turnover is essential for replacing damaged macromolecules [2].

In human cells, SAI is evident in various organelles. For example, the SAI of mitochondria facilitates uniparental transmission, a form of inheritance where genes originate from only one parent. SAI in components of synthetic replicators of human genes promotes replicator cycling, leading to increased complexity. However, SAI also incurs costs, such as the energy and materials needed for creating and degrading unstable components. Despite these costs, SAI enhances genetic diversity and reproductive fitness and may contribute to aging by maintaining deleterious alleles and losing resources.

SAI likely operates at other levels of biological organization, necessitating combined theoretical and experimental approaches to fully understand its impacts. Despite our growing knowledge, many challenges remain [2].

## References

- [1] Allen JA. (1877). The influence of physical conditions in the genesis of species. *Radical Review*, **1**, 108-140. <https://people.wku.edu/charles.smith/biogeog/ALLE1877.htm>
- [2] Tower J. (2024). Selectively advantageous instability in biotic and pre-biotic systems and implications for evolution and aging. *Frontiers in Aging*, **5**. <https://doi.org/10.3389/fragi.2024.1376060>
- [3] Vuong QH, Nguyen MH. (2024). *Better Economics for the Earth: A Lesson from Quantum and Information Theories*. <https://www.amazon.com/dp/B0D98L5K44>

