Title: Extending the reliability model on cellular aging.

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ABSTRACT

Aging is defined as the increasing chance of failure with time. For biological organisms, increasing risk of functional failure can lead to sickness and ultimately death. Thus, discovering the manner by which cell components of a biological system age is an important question. In the realibity model of cellular aging, components are considered functionally redundant - if one dies, the entire system does not fail, because the components are connected in parallel. The system will only fail when all of the components fail. In the human body, the cells that make up organs represent the components, and the organs represent the system. The individual components can either have the same failure rate (homogeneous) or different failure rates (heterogeneous). Biological aging can be characterized by the Gompertz model that indicates an exponential increase of mortality rate. Previously findings suggest that biological aging can arise from a system with a random number of redundant components with constant failure rates. We found that heterogeneous components can also give rise to biological aging as described by the Gompertz model. We are also studying the impact of varying functional modules and heterogeneous components on the emergence of biological aging characteristics. Our research can help us better understand aging, a fundamental problem of biology.

Aging

“The increasing risk of failure with the passage of time”

Aging is the degradation to failure; the maturation of diseases with age. Diseases usually contribute to aging.

Gompertz: Death rates increase exponentially with age

Individual components are in parallel (system will still work without one component), systems are in series (if one system doesn’t work, the entire organism fails).

System with redundancy accumulates damage

Reliability Theory:

As we get older, failure rates increase

General theory of systems failure developed by mathematicians

Question

Can we mathematically explain how humans age biologically? Does it match the Gompertz model?

Hypothesis

We believe that if we create a code to model multiple biological systems, the failure rate will increase exponentially with age following the Gompertz model.

Plan:

Design a code, using the original, to graph multiple biological systems with multiple redundant components.

Expectations:

We think we can further prove that heterogeneity can reproduce the exponentially increasing failure rates as seen in Gompertz Law