Biological robustness is an important characteristic of biological systems that enables the system to retain its specific functions in response to external disturbances and stimuli. Robustness requires the system to change its movement patterns in a flexible manner. (Kitano, 2004)

Biological fragility is also an inherent property in biological systems, i.e. a biological system feels a certain level of vulnerability to any disturbance. A system is vulnerable when it resists abnormal mutations.

It is very common to observe these two properties in some species. For example, robustness in the E. coli system is capable of chemotaxis over a wide range of chemo-attractant concentrations. ("<Alon-1999-Robustness-in-bacterial-chemotaxis.pdf>,")
When we put a drop of a chemical substance into the world of bacteria, the drop will spread. The E. coli will change its direction of movement depending on whether the chemical is something it wants to avoid. However, it still drives through the original tumbling or straight ahead movement pattern. It is worth noting that the E. coli changes the speed of its movement, but the original form of movement remains the same. In another example, researchers studying a small fish called the threespine stickleback, found that this "fragile" region of DNA creates genetic hot spots that mutate much faster and larger than neighboring sequences. This region is key to vertebrate evolution. The resulting changes can help an organism stay well ahead of its peers in the evolutionary arms race.("<1901.0062v1.pdf>,")

Biological robustness plays a crucial role in different places of operation, from single cells, organelles and whole organisms. To synthesize proteins, the genetic code translates the DNA or mRNA coding into amino acid sequences in groups of one or three nucleotides. If there is a failure in the synthesis process, this can change the amino acids in the code and may alter the protein structure and function. Such a mistake could have a huge negative impact on the cell and the whole organism. Fortunately, genetic codes have some robustness, with built-in redundancy and error correction mechanisms. (Davis et al., 2021) A similar redundancy phenomenon occurs in cells. When cells in some tissues are damaged, other identical or similar components replace the damaged cells. In addition, feedback control facilitates the achievement of robustness. ("<Freeman-2000-Feedback-control-of-intercellular-s.pdf>,") Feedback control can promote hormone secretion and inhibit hormone secretion. For example, when the body's blood glucose decreases, the body's glucagon can prevent the blood glucose from going too low. When blood glucose rises, the body will secrete insulin to prevent blood glucose from going too high. If the body does not have such a system of checks and balances, insulin loses its effect, which may lead to diabetes.

It is important to understand the intrinsic nature of robustness and fragility. They determine the patterns of systemic failure and effective measures that facilitate the understanding of genes, diseases, and the design of therapies.

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