Fuzzy logic predicts cell aging

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The process of aging disturbs a broad range of cellular mechanisms in a complex fashion and is not well understood. Computer models using fuzzy logic might help to unravel these complexities and predict how aging progresses in cells and organisms, according to a study from Drexel University in Philadelphia and Children's Hospital Boston.

"One important goal of computational approaches in aging is to develop integrated models of a unifying aging theory in order to better understand the progression of aging phenotypes grounded on molecular mechanisms," said Andres Kriete, Associate Professor at Drexel's School of Biomedical Engineering, Science and Health Systems and lead author of the study.

The study, which will appear in the June issue of *PLOS* Computational Biology , relates progressive damage and dysfunction in aging, dubbed a vicious cycle, to inflammatory and metabolic stress response pathways. Interestingly, the activation of these pathways remodels the inner functioning of the cell in a protective and adaptive manner and thus extends lifespan.

This is the first time that scientists have applied fuzzy logic modeling to the field of aging. "Since cellular biodynamics in aging may be considered a complex control system, a fuzzy logic approach seems to be particularly suitable," said Dr. William Bosl, co-author of this study. Dr. Bosl, a staff scientist in the Informatics Program at Children's Hospital Boston, developed a fuzzy logic modeling platform called Bionet together with a cell biologist, Dr. Rong Li of the Stowers Institute for

Medical Research in Kansas City, to study the complex interactions that occur in a cell's machinery using the kind of qualitative information gained from laboratory experiments.

Fuzzy logic can handle imprecise input, but makes precise decisions and has wide industrial applications from air conditioning to anti-lock break systems in cars, using predefined rules. In a similar fashion, the aging model relies on sets of rules drawn from experimental data to describe molecular interactions. "Integration of such data is the declared goal of systems biology, which enables simulation of the response of cells to signaling cues, cell cycling and cell death," said Glenn Booker, who is Faculty at the College of Information Science and Technology at Drexel and co-author on the study.

Applications in aging are currently geared towards deciphering the underlying connections and networks. "We have to realize that the real strength of computational systems biology in aging is to be able to predict and develop strategies to control cellular networks better as they may be related to age related diseases," said Dr. Kriete, "and our approach is just a first step in this direction."

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