The Logic and Beauty of Cosmological Natural Selection

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I have a prediction. There is a scientific hypothesis, formulated over 20 years ago, that we will one day look back on, when the evidence is in, and say "Of course that was right! What a spectacularly powerful idea!"

The hypothesis is cosmological natural selection, and its power, beauty and logic provide what may be the best scientific explanation for the existence of complexity and life in the universe.

The explanatory power of cosmological natural selection directly addresses, rather than ignores, one of the very deepest fundamental scientific mysteries. If the laws and parameters of nature's particles and forces were even just a little bit different, the formation life would be impossible. If the ratio of electrons to protons, the expansion rate of the universe, the relative masses of elementary particles, or relative strength of several of the physical forces were not *extremely* close to what they are now, stars and the complex molecules that lead to life could never have developed.

The odds of randomly hitting upon a life-permitting universe seem infinitesimal. When discussing how a relatively small change in the magnitude of dark energy would preclude life, physicist and author Paul Davies wrote, "The cliché that 'life is balanced on a knife-edge' is a staggering understatement in this case: no knife in the universe could have an edge *that* fine." The problem is to explain why the universe's constants and laws are so precisely fine tuned as to allow for complexity and life. Even if, as another physicist and author Victor Stenger argued, this "fine tuning problem" can largely be explained by established physics, the deep mystery of why our universe has specific parameters and laws that allow complexity and life to emerge in the first place still remains.

Okay, so we have the significant problem of explaining organized complexity and the appearance of design.

We have been here before.

Before Darwin, the prevailing view was that each species was specially created and did not change over time. We now know that species are not timeless or designed, and that cumulative change is possible naturalistically through generations by Darwinian evolution.

Referring to biological complexity, evolutionary biologist and author Richard Dawkins wrote, "The theory of evolution by cumulative natural selection is the only theory we know of that is, in principle, capable of explaining the existence of organized complexity." Some have called evolution by natural selection the single best idea anyone ever had.

If that is true, why stop at biology? "Nothing in biology makes sense except in the light of

evolution," evolutionary biologist Theodosius Dobzhansky wrote. Is it possible that, faced with a similar daunting challenge to explain complexity and the appearance of design, nothing in *cosmology* will make sense except in the light of evolution either? Obviously, evidence is essential in science, and we'll get to that. If thought of broadly, in biology it's evolution all the way down. Maybe in cosmology, it's evolution all the way up as well.

The most full proposal for the mechanism of cosmological natural selection comes from physicist Lee Smolin.

Here is the mind-blowing hypothesis that he first outlined in 1992 in his book *The Life of the Cosmos*. Throughout the universe, stars that collapse into black holes squeeze down to an unimaginably extreme density. Under those extreme conditions, as a result of quantum phenomenon, the black hole explodes in a big bang and expands into its own new baby universe, separate from the original. The point where time ends inside a black hole is where time begins in the big bang of a new universe. Smolin proposes that the extreme conditions inside a collapsed black hole result in small random variations of the fundamental physical forces and parameters in the baby universe. So each of the new baby universes has slightly different physical forces and parameters from its parent. This introduces variation.

Because of their inherited characteristics, universes with star-friendly parameters will produce more stars and reproduce at a greater rate than those universes with star-unfriendly parameters. So the parameters we see today are the way they are because, after accumulating bit by bit through generations of universes, the inherited parameters are good at producing stars and reproducing.

So that would be a logical explanation to the deep "fine tuning problem" – the parameters in our universe are the way they are because of non-random naturalistic cumulative inherited change through reproductive success over time. If correct, we live in a lineage of offspring universes – which visually could be depicted like the expanding branches on the biological tree of life.

The existence of stars is a prerequisite for the formation of life. This is because carbon and most of the other complex molecules that allow for life are created in stars. So the same conditions that promote the most new universes would be the same conditions that allow for life.

Smolin takes great pains to claim his hypothesis is scientific because it is falsifiable. He proposes several ways that his conjecture can be disproved. But the larger point for us is not whether Smolin's specific proposed mechanism for cosmological natural selection is true. The point here is to emphasize the power, beauty and logic of cosmological natural selection as a scientific hypothesis to explain complexity and the appearance of design, even if the precise mechanism of cosmic heredity and variation has not been determined.

The claim of cosmological natural selection is not that it has a 1 to 1 exact analogy to biological natural selection. For evolution by natural selection to manifest its extraordinary power, the fundamental feature of the process that must be preserved is differential reproductive success of heritable variations and cumulative change. The technical details of what constitutes environments, populations, etc., and whether or not phenomena like species, mating opportunities and direct competition come into play, depend on the local specifics. So, the claim is that the hypothesis of cosmological natural selection maintains the essence of a *universalizable* natural selection process, with all its explanatory majesty.

The real criticism of cosmological natural selection as a scientific hypothesis is its lack of direct evidence at this point. There is no direct evidence that the universe reproduces. Without that, no natural selection, even before issues of variation and selection come into play. True enough. But keep in mind that from a direct evidence perspective, cosmological natural selection is no worse off at this point than proposed scientific alternatives. There is no *direct* evidence that universes are created by quantum fluctuations in a quantum vacuum, that we live in a multiverse, that there is a theory of everything, or that string theory, cyclic universes or- brane cosmology even exist.

And the major proposed alternatives in cosmology do not directly or logically explain the "fine tuning" problem for the existence of complexity and life. Instead, they suggest things like some sort of inevitability, design, unimaginably incalculable luck or an infinite number of multiple universes where every possible universe exists. That last one is enough to make Occam cut his throat with his razor.

If, ultimately, some version of cosmological natural selection is proved true, as I think it will be, it will go well beyond giving the best logical explanation for why our universe's parameters allow for complexity and life. There would, in addition, be deep and profound implications related to human meaning and existence.

In a world of branching universes conducive to life, ultimate cosmic doom may be avoided, keeping alive the possibility of eternity – not for us as individuals, or for Homo sapiens, but for the existence of life at large in the cosmos. If cosmological natural selection proves true, life almost certainly is not unique in the history of the cosmos. As was shown with biological natural selection, we are of nature and part of nature. The universe could be further understood as a self-coherent and self-creating whole, without the need for anything outside itself to give it law, meaning or complexity.

If cosmological natural selection proves true, we would not live in a determined world, but in a changing cosmos with an open future. This can be interpreted as optimistic and hopeful. But while processes such as natural selection may allow for the development of life—and there is something spectacularly marvelous about that—there is no evidence that the universe as a whole has consciously planned anything, has life as its conscious goal or consciously cares about our fate. The human tension between the heroic and the humble, this blending of the significant and the insignificant, can be a source for comedy, tragedy or inspiration.

Ultimately, it will come down to evidence. Science rules by evidence. Our minds expand, while the God of the gaps gasps.

If evidence proves any one of the cosmological alternatives—or an entirely new idea

altogether—we will embrace reality, no matter where it leads, and be struck with awe at our ability to discover the grandest of cosmological truths and our place in the universe.

The views expressed are those of the author(s) and are not necessarily those of Scientific American.

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