Without Miracles

Universal Selection Theory and the Second Darwinian Revolution

Review by
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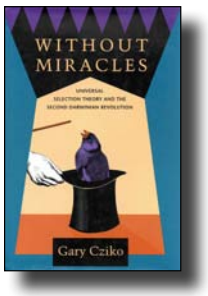

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By Gary Cziko

The thesis of the USA psychologist Gary Cziko is that there is a universal process of Darwinian evolution that is responsible for knowledge at all levels, and not only at the biological level.

Cziko relates "knowledge" to the fitness of living beings, to their adaptation to the environment. Knowledge as the product of the interaction with the environment (and as the necessary cause for survival in that environment) implies that all knowledge is created through a Darwinian process of blind variation coupled with environmental selection.

Cziko observes that there are really two kinds of fitness: living beings are adapted to their environment when they are born, and living beings are capable of adapting to changes in their environment during their lifetime. A theory of fitness has to deal with both forms of fitness, the one that has been shaped over the centuries and become part of a species' identity and the other that is shaped over an individual's lifetime and becomes part of the individual's identity ("instinct" and "learning"). He recasts both as forms of "complexity", respectively adapted and adaptive complexity. He later recasts both as forms of "behavior", one that differentiates the species within the realm of living beings, and the other that differentiates the individual within the species.

There is a process at work in living organisms that seems to defy Physics. A muscle gets stronger when it is used more often, and weaker when it is not used. Objects, on the other hand, wear out when they are used. A car does not improve with "exercise" the way an animal does.

The Austrian ethologist Konrad Lorenz saw instinct as having been shaped by blind variation and natural selection: it is "knowledge" acquired over millennia that (in modern terms) is now encoded in the genome of a species. However, the same behavior does not yield the same outcome unless the environment remains exactly the same; which, in general, it doesn't. William James noted that a living being is capable of achieving consistent goals using (slightly) different behaviors. Individuals can "adapt" to circumstances.

Examples of "ontogenetic" adaptation are the muscles that get bigger the more they are used and the immune system, that "learns" what antibodies to make based on which ones are "used" to fight antigens. The immune system is particularly effective in its job. However, it operates on an absolutely blind basis: it creates all the time a lot of different kinds of antibodies hoping that, when attacked, at least one will work against the invader. It is the diversity of its army of soldiers (and the fact that they are permanently available) that makes it effective in fighting the enemy, not a careful training of each soldier and a timely deployment of them. It's diversity and continuity that matter. And they are due to a process of blind variation, not to a process of careful engineering. (Another key feature for the proper functioning of the immune system is, of course, that it produces only antibodies that destroy antigens and no antibodies that destroy body cells; in other words, it is capable of distinguishing self from nonself).

The "blindness" of selectional processes turns out to be advantage in other ways as well. There are several examples of "functional shifts", i.e. of parts that evolved for a purpose but then ended up being used for a different purpose, simply because it worked (what the USA biologist Stephen Jay Gould termed "exaptation"). The current use of an organ or behavior does not necessarily explain its origin. It may well be that it originated for a different function.

The other major example of "ontogenetic" adaptation is the brain, that is shaped not only by the genes but by experience. Interaction with the environment "selects" which synapses are useful and eliminates the ones that are useless.

Drawing from Konrad Lorenz's evolutionary epistemology of 1941, Cziko views knowledge as adaptation of the brain to the environment. A-priori knowledge (the innate knowledge of entities such as time and space) is the product of the biological evolution of the human brain. During our lifetime the senses provides us with true information about the environment because they have been selected over

the millennia based on their usefulness. Therefore the world is not an illusion, and we know it by adapting to what it is.

Cziko observes that "fitness" has to do with "purpose": there is fit when the structure of an organism serves a purposeful function. Animal behavior is purposeful and changes the environment that operates on the animal's behavior. Stimuli influence responses, but responses also influence stimuli. William Powers' "perceptual control theory", according to which behavior controls perception as much as perception determines behavior, A control system is as blind as the immune system that creates an army of antibodies. Nonetheless, a control system exhibits a behavior that appears to be "purposeful". It is, in turn, "controlled" by higher-level control systems. An organism is ultimately a hierarchy of control systems, each of which senses something in the environment and tries to control it. Instinctive behavior is the result of the interaction between control systems that have internal goals. Each control system must have survival value if it is still part of an organism. In a sense, there is no learning: there is just the blind functioning of a network of control systems. In another sense, that "is" precisely what we call "learning": a control system at work. When something changes in the environment, the control system senses it and needs to restore its internal goal. It does so by triggering random responses and rewarding the ones that move it closer to its goal. A hierarchy of control systems can create the illusion of learning and of intelligence (as in Valentino Breitenberg's progressively complex robots).

Cziko argues that there is a Darwinian selection not of behaviors but of control systems.

Cziko applies this selectionist approach to problem solving. Solving a problem consists in visualizing it correctly. In his opinion the brain produces many different visualizations of the problem until one "fits". Then the solution is obvious. The brain produces a large number of ideas. Those that are "useless" are weakened; those that are useful are reinforced. Borrowing from the USA psychologist Donald Campbell ("Evolutionary Epistemology", 1974), Cziko views a selectionist process (blind variation and selective retention) at work in all the brain functions, from perception (recognizing that something is something) to problem solving. At all levels the brain does not really "know" what to do: it just takes guesses, and the correct guesses are rewarded. Thinking originates from a population of guesses that evolves based on their usefulness or uselessness. Knowledge is the result of a hierarchy of selectionist processes, starting with the biological one studied by Darwin.

"Learning" is necessary because animals need to adapt to changing environments. The brain and the immune system allow animals to find food and to fight lethal viruses. Humans have also developed a higher form of "learning" that consists in cultural knowledge. Cziko shows that it too obeys a process of blind variation and selective retention. Even when we learn something from somebody else we are simply interacting with the environment (the "somebody else") and fine-tuning our knowledge based on that interaction. Both technological and scientific evolution, for example, is due to a number of wildly different "trial and error" processes.

Cziko applies "universal selectionism" to a number of different fields. The most interesting is language. Following the USA linguists Elizabeth Bates and Brian MacWHinney ("Competition, variation, and language learning", 1987), Cziko shows that a selectionist approach can well complement Chomsky's nativism to explain how children learn language. There might be innate linguistic skills in the brain (selected over the millennia by evolution) but children learn a language by the same "trial and error" process that Nature employs everywhere. Children try words and sentences and reinforce the ones that "work", just like the brain and the immune system try synapses and antibodies and reinforce the ones that work (or, better, the ones that work are reinforced by the positive outcome).

P.S.

Cziko opens his book by exclaiming: "The universe has somehow acquired awareness of itself". He is implying that the universe created us humans, who are endowed with the faculties of consciousness, and therefore in us the universe has created a part of itself that is aware of the whole. That's an opinion (rather difficult to prove). It could well be that the universe has always been aware of itself, and we humans are just the current manifestation of that self-awareness (one of the current ones). And it could well be that we are "not" aware of the universe but just of our little niche.