

SUMMARY

THE BIG PICTURE

SEAN M. CARROLL



Summary of “The Big Picture” by Sean M. Carroll

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Learn how to see the big picture of life.

Introduction	5
The Foundation of Physics	6
The Law of Cause and Effect	8
Fundamental and Emergent Theories	9
The Power of Entropy	10
Entropy and Evolution	11
The Evolution of the Mind	12
Final Summary	13



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Introduction

Why do bad things happen to good people? Where do we go when we die? What's the purpose of my life? We might have innocently asked these questions as kids but they take on deeper meaning when we stumble through adulthood only to find that the answers don't automatically appear with time. And although we're still unable to provide definitive answers to many of these questions, the silver lining is that advances in modern science have taken us to new heights of understanding. Through the course of this summary, we'll explore the discoveries that add new insights to our world.

The Foundation of Physics

Prior to the advent of modern science, how did people explain shocking phenomena? They attributed it, of course, to the hand of God. Although different religions offered different interpretations, one thing they all had in common was that people relied on them to explain the inexplicable. Without this answer, people were fearful in the face of natural disasters, extreme weather, and the mysteries of human behavior. It was easier to believe in a God who controlled these things than to consider the complexities of the universe. Fortunately, however, the advancements of science and technology have provided us with new explanations for the inner workings of the world.

For example, Nobel Laureate-winning physicist Frank Wilczek developed the Core Theory to provide an explanation for some fundamental facets of the universe. Although the Core Theory can't explain everything or answer questions like, "What is the meaning of life?" it can explain the interaction of every known particle with factors like nuclear forces, gravity, and electromagnetism. In short, it addresses most of the scientific and biological functions that control our everyday lives. And although it has shed new light on a variety of natural phenomena, it can also be used to explain the seemingly mystical and supernatural. For example, although telekinesis and telepathy make compelling plots for Stephen King novels, the Core Theory can answer the question of whether or not they can exist in real life. (Sorry to disappoint you, but the answer is a resounding "no.") That's because crossing symmetry-- an important facet of the Core Theory-- tells us that certain particles would have to be present in the brain in order for telekinesis to exist.

But if it existed, the Core Theory argues, scientists would have been able to prove and duplicate it by now. If you're thinking that sounds a bit presumptuous, think again! Every particle that the mind can produce or interact with has already been discovered and studied. It could therefore be recreated in a laboratory experiment. But no such particle has ever been

found, despite multiple attempts to study collisions between every brain protocol and the responding antiproton necessary for this collision. This means that, even under unconventional circumstances like the sort depicted in film, the particle necessary to create telekinetic powers does not exist.

The Law of Cause and Effect

This is another principle that informs our understanding of the world and our daily lives and as such, we think it's pretty important. But in fact, recent studies have indicated that causation does not inherently infer correlation. Why? Well, according to the author, this is because of our increased understanding of time and space. To dig into this theory, let's consider what would happen if an object was in space. It is not touching or near anything that could cause it to move. There are no forces creating a current of movement in its environment. Yet, despite the absence of these factors, that object will still be in motion, still moving through space.

Modern physicists understand that this is the result of a principle called the conservation of momentum, which means that objects can stay permanently in motion without any discernible cause. Thus, from this, we can infer that since the object is still moving-- even though nothing has caused it to move-- the conservation of momentum is at work here rather than the law of cause and effect. This means that every aspect of our lives, every motion is not, in fact, governed by causation. So, as a result, we can think critically about-- or even entirely disprove-- a principle that has been widely accepted for centuries!

Fundamental and Emergent Theories

Every time we revolutionize our understanding of a theory or principle, it generates new questions and invites us to view our conceptualization of the world through a different light. This was certainly the case when the law of cause and effect was disproved and it prompted scientists to consider the world in two new, vastly different ways: on a fundamental level and an emergent level. Put simply, the fundamental viewpoint invites us to explore concepts on a microscopic level while the emergent perspective necessitates looking at the big picture.

To understand how these differing viewpoints work, let's apply them to our concept of something simple and common, like the existence of clouds. On a fundamental level, we understand that clouds are simply an accumulation of tiny water crystals which are light enough to float in the air. We can use this understanding to examine clouds on a microscopic level and analyze these tiny water crystals. But on a fundamental level, we can zoom out and look at the bigger picture of how clouds function in real life. From this perspective, we can consider how rain occurs because those tiny water droplets join together and eventually grow heavy enough to be pulled to the earth because of gravity. We can examine how clouds reflect heat and keep the earth warm or how they function as shade. We can even analyze the relationship between clouds and extreme weather like hurricanes, tornadoes, and snowstorms.

Thus, from these examples, you can see that although each viewpoint is different in terms of its focus and scope of observation, they are both uniquely helpful and important to scientific study. One is not better or more useful than another; rather, it's merely a question of identifying the best viewpoint for a particular scientific problem. And both of these perspectives can help us understand a major change to our conceptualization of science, like debunking the law of cause and effect.

The Power of Entropy

You might vaguely remember “entropy” as a fleeting concept from your high-school textbook, but unless you’re a physicist, most of us don’t need or want to remember its definition in our daily lives. But to put it in the most simplistic terms, entropy is the measure of uncertainty or randomness. We use entropy to determine the amount of energy which is unavailable in any given object and therefore, how much energy cannot be used by that object. If your head is already spinning, just know that-- for the purposes of this chapter-- the most important thing you need to know about entropy is that we can use it to inform our understanding of time.

How does it work? Well, let’s start by considering the human perception of time. For example, we remember the past but not the future, and from this, we conclude that we haven’t experienced the future yet and therefore don’t know what will happen in it. Likewise, we are younger in the past but older in the present and future, so we conclude that time is asymmetric. This perception is the result of entropy or the uncertainty of what we can’t yet know. Scientists have therefore studied the law of entropy and confirmed two things: that entropy will only increase with the passage of time and that it cannot reverse and decrease with time. Although this may not answer every question we have about the passage of time, at the very least, we can understand that entropy forms the foundation for the human conceptualization and experience of time.

Entropy and Evolution

Because entropy is the measurement of randomness and uncertainty, you might assume that it causes chaos rather than any form of structured growth. But actually, nothing could be further from the truth! The author observes that there are actually some instances in which an excess of entropy can result in the development of complex and organized systems. That's because entropy doesn't occur in a linear fashion. Rather, it exists on a sort of curvy continuum in which minimal complexity exists on both ends but a loop of high complexity is present in the middle.

To visualize this, consider what happens when you blend the ingredients of an Espresso Martini. When you first start pouring the vanilla vodka into the espresso, the two liquids remain separate at first. But then the vodka drifts to the bottom of the container, leaving no discernible signs that another liquid has entered the espresso. In the middle, however, the two liquids are coming together, flavors meshing until they reach the perfect harmony that forms their delicious blend of flavors. This internal complexity had to occur in order for the flavors to fuse and form one cohesive flavor rather than the impression that you're drinking two separate things from the same cup.

And we can apply this same analogy to the development of the universe. When entropy was at its lowest-- (at one end of the minimal complexity spectrum)-- that's when the Big Bang occurred. This, of course, shook everything up in much the same way that the ingredients of an espresso martini are jumbled up in a cocktail shaker. But after the initial outburst, entropy began gravitating toward the final end of the spectrum: back toward simplicity again. So, even though entropy is the measure of chaos, randomness, and the things we do not know, it's still instrumental in creating complex systems like our very own planet Earth. (Or the perfect espresso martini).

The Evolution of the Mind

Have you ever wondered how the human state of consciousness evolved? Or wondered how and why human beings became aware of their existence? What makes an alert and conscious life form? As is the case with many of the big picture questions we discussed at the beginning of this book, we can't fully answer all our questions about consciousness right now. But we can theorize about how it came to be. In fact, scientists have already developed new conclusions about the evolutionary stages of consciousness! For example, Malcolm McIver, a prominent bioengineer, theorizes that the very first species' transition from water to land is a major hallmark in the evolutionary development of consciousness. He supports his theory by arguing that underwater organisms exist in a state of reaction-based survival. Their critical thinking skills are underdeveloped because their primary objective is survival.

But when the very first sea creatures somehow transitioned to life on land, they recognized that they could now see farther and more clearly than their underwater perspective had allowed them. As a result, they could detect threats at a more advanced pace by identifying them from a distance instead of reacting when the threat was already upon them. The ability to detect these threats therefore presented them with a skill they did not have before: the opportunity to plan in advance. McIver describes this as the infancy of consciousness, a baby step toward critical thinking and advanced reasoning. However, we don't yet understand how this concept works in relation to the atoms in our brains to facilitate a state of consciousness. However, as our previous study of scientific exploration has already shown us, even though we don't know the answers yet, there is no limit to what we can discover!

Final Summary

We have a lot of “big picture” questions about the universe. And throughout the history of human existence, we’ve tried to answer these questions through religion, science, and the study of the mind. However, Carroll posits that science is the only true answer. Even if we haven’t yet discovered the answers to all of life’s big picture questions, he believes that science will enable us to explore, hypothesize, and ultimately develop a solution. To illustrate the power of scientific thinking, Carroll provides readers with examples of problems science has solved.

Whether it’s using the Core Theory of physics to explain every facet of our daily existence on the planet or debunking the existence of telekinesis, telepathy, and the law of cause and effect, scientific thinking informs our lives in more ways than we realize. We can also use science to understand the inner workings of time and the evolutionary development of consciousness. As a result, Carroll believes that if we apply these scientific principles as our guide, we can ultimately answer the world’s biggest big-picture questions.



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