

# Relativized Evolution

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# Chapter 1

## Introduction

There are two goals of this treatise. The first is to connect biological evolution to an epistemology. It is my hope to give evolution a theoretical foundation in addition to the empirical evidence. The second goal is to develop the proposed theory. Differences with the received theory of evolution will be discussed as well as potential solutions to traditional problems.

As a general strategy the General Theory of Relativity will be used as an example and guide throughout the process. First it will be used in establishing the required epistemology and then as a guide for structuring the new theory. However, even as much as General Relativity is relied upon, the updated theory of evolution must still stand on its own.

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The epistemology is drawn from J. Hintikka's work. The biological theory is entirely my own. The rest can be confirmed with only a brief survey of relevant material.

## Chapter 2

# Epistemology

### 2.1 Knowledge and Certainty

There are different ways to understand knowledge but for this investigation we will start with certainty. If some fact is absolutely certain then that fact can be called knowledge. For example, if a claim that this sentence was originally written on a Monday has absolute certainty, then it is a fact of knowledge that this sentence was originally written on a Monday.

Absolute certainty is an incredibly high threshold for determining knowledge. Even if the above sentence was originally written on a Monday, there is some chance that I had been mistaken about the day. Mistaking the day isn't a hard mistake to make, so there is some chance – even if it is only a small one – that the claim is wrong. Armed with this doubt we can no longer say that we have absolute certainty and hence we cannot count the above claim as knowledge.

Since philosophers have doubted even the most established laws of logic, this scheme leaves us with almost no knowledge at all. Using absolute certainty is hence untenable as a condition for general knowledge because its too hard to satisfy.

### 2.2 Mistakes

If we return to the example, we can see that it failed because knowing the day of the week is something that we can make a mistake about. However, mistaking the day of the week is not a mistake that can be made every single day. To make a mistake means that you have done something out of the ordinary; if you never get the day of the week right, or only get it correct with a one in seven chance, then it wouldn't be a mistake when you got it wrong. It would be that you do not know how to determine the day of the week.

The implication is that acting certain ways implies that you do not know how to perform a particular activity. Specifically, these actions are not **ordinary** mistakes because to make an ordinary mistake means that you regularly perform

the activity correctly, but you did not in that instance. For example, when I asked my four year old cousin when his birthday was, he answered “Six weeks.” I was impressed until I asked him when his next birthday was and he answered “Seven weeks.” When I asked him, “When were you three?” he said, “Train party.” He knew that he had a train-themed birthday party when he turned four, so he understood that your age changed when you had a birthday, but he did not yet understand that birthdays happen only once a year. It wasn’t that he made a mistake, such as adding up the weeks before his next birthday incorrectly: he didn’t yet fully understand about birthdays or time.

I, however, just saw Chile defeat Switzerland live in the World Cup opening round in South Africa, and the match was scheduled for a Monday. I’ve seen (at least) three independent automatically updating electronic calendars: one on an established news site on the internet, one on a cellular phone network and one locally running on my computer. I recall that yesterday was Sunday. I have done everything that can be expected of me to determine that today is Monday.

Barring the fantastic skeptical situation in which anything is possible, e.g. a demon has simulated the entire world in a way to make it seem like a Monday when it really is not, there is no way I can be mistaken about the day of the week at the moment. If today isn’t Monday, either I have lost my mind or the rest of the world has.

It is one thing to establish the day of the week. It is another to establish a fact or law of science. However, if we find situations in which we cannot be making even ordinary mistakes, then we have an opportunity to discover knowledge.

## 2.3 Sense and Science

There are some things we cannot make a mistake about. One is that our senses are limited: for all that we can see, there are things too small or too far or simply out of our field of vision, and similarly for the other senses. It would be something amazing and fantastic if we, unaided, could see through walls, hear people talking on the other side of the world or feel sub-atomic particles moving about. If we had these capabilities it would be something different and special compared to our senses.

This is all to say: we know our senses are limited.

Although this may not seem like much, it is actually a major victory for human intelligence. Consider this famous passage from Einstein’s “Relativity: The Special and General Theory”<sup>1</sup> in which he describes a man in a sealed box suspended from a rope being pulled through outer space:

Suppose that the man in the chest fixes a rope to the inner side of the lid, and that he attaches a body to the free end of the rope.

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<sup>1</sup>Einstein, Albert. *Relativity: The Special and General Theory*, Robert W. Lawson trans., Methuen & Co Ltd., 1920, <<http://www.gutenberg.org/etext/5001>>

The result of this will be to stretch the rope so that it will hang “vertically” downwards. If we ask for an opinion of the cause of tension in the rope, the man in the chest will say: “The suspended body experiences a downward force in the gravitational field, and this is neutralized by the tension of the rope; what determines the magnitude of the tension of the rope is the gravitational mass of the suspended body.” On the other hand, an observer who is poised freely in space will interpret the condition of things thus: “The rope must perforce take part in the accelerated motion of the chest, and it transmits this motion to the body attached to it. The tension of the rope is just large enough to effect the acceleration of the body. That which determines the magnitude of the tension of the rope is the inertial mass of the body.” Guided by this example, we see that our extension of the principle of relativity implies the necessity of the law of the equality of inertial and gravitational mass. Thus we have obtained a physical interpretation of this law.

In the last two sentences Einstein talks about the equality of inertial and gravitational mass. It sounds like fancy physics, but it is derived from the example which says that we can’t tell the difference between being pulled by gravity and being pulled by a rope. Or, even more briefly, we are limited to sensing only one kind of acceleration.

The history of how this human limitation entered into gravitational physics is an important story and is the subject of the next chapter.

## Chapter 3

# A Short and Selective History of Gravity

Regardless of the accuracy, predictive power, simplicity or any other measure that we have of a scientific theory, every theory of motion throughout history must try to answer this question:

*Why does something change its place?*

### 3.1 Aristotelian Locomotion

For Aristotle each object has its own nature which determines its motion. Unfortunately, what we usually mean by motion is not exactly what Aristotle meant by it: motion is a general term which includes many different kinds of changes and alterations, locomotion being a subclass. For instance generation, as in a seed growing into a tree, or a rock warming from being cool would be considered motions. Motion is so general that being built, learning, doctoring, rolling, leaping, and ripening are all examples of different motions.

Secondly, even when discussing locomotion, there are two kinds: natural and unnatural. Unnatural locomotion occurs when one object causes another object to move in a way that it would not naturally move. For example, if you were to carry a stone to the top of a hill or build a house with it, that locomotion of the stone would be considered ‘unnatural’ because a stone would not move that way on its own.

So what is ‘natural’ locomotion then? Natural locomotion occurs when an object moves towards its place. Generally speaking the place of light things, such as air, is up and the place of heavy things, such as earth, is down. Since Aristotle believed in a spherical Earth, down meant towards the center of the Earth and up meant away from that center.

However, each thing determines its own place; the general categorization of things into heavy and light, or earth and air, is not the determining factor as

to the place of a specific entity. A thing's place is determined by that entity's specific nature, just as it is the seed's nature to grow into a particular kind of tree. Therefore the answer to why something changes its place – in the modern physical sense – is that its specific nature, the entity itself, causes itself to locomote to that place.

## 3.2 Hypothesis Non Fingo

About 2000 years later, Galileo decided to test Aristotle's theory of locomotion using modern methods. He found that Aristotelean Motion was wrong and developed his Law of Inertia. In its common form as 'Newton's First Law,' it reads: Things at rest tend to stay at rest and things in uniform motion tend to stay in uniform motion unless acted upon by an external force. All motion is governed by this law, and it explicitly states that it is not a nature, an internal cause, but an *external force* that moves objects.

Although this is a much more accurate view of motion, it fails to answer why things move in certain situations. When I let a stone fall from my hand, the stone is at rest in my hand and then it falls to the ground. If I did not throw it, and since it must not have moved due to an internal cause, there was no known force that moved the stone to the ground.

Later that century Newton invented his Law of Universal Gravitation which nearly perfectly describes the attraction between objects. However, his theory of gravity makes no progress in answering why objects move the way they do: it merely *describes* the motion. Moreover, Newton found the idea that a force like gravity could be active without some intervening medium, e.g. across the vacuum of space, absurd. Though he tried multiple times to find an explanation as to how gravity works, it was to no avail. Eventually he said that he wouldn't even field a guess: he would feign no hypothesis, "Hypothesis non fingo." Despite these problems, Newtonian Gravity remained state of the art for the next 200 years.

## 3.3 General Relativity

In Einstein's theory of gravity, General Relativity, space itself changes shape. This deformation of space is directly in contrast with Newtonian Gravity. Newtonian Gravity acted at a distance across an unchanging space; General Relativity acts by changing space itself and distant objects act with the locally deformed space. This solves Newton's difficulty.

To answer why objects move, General Relativity postulates that the way that space is deformed causes objects to move. The deformation of space is described as a field and every mass creates a gravitational field. It is the Earth's gravitational field that causes a stone to fall from my hand to the ground. The stone has a gravitational field of its own, but since the stone is much less massive its field is likewise much smaller, so small that we generally don't notice it.

General Relativity is also more applicable than Newtonian Gravity. Newtonian mechanics only work when the observer is not experiencing an acceleration. This means that the observer is either at rest or in uniform motion. If a force is applied to the observer, the mechanics cease to work. Since General Relativity applies under accelerated motion as well as uniform motion, it is a more 'general' theory.

Given General Relativity, one might wonder how masses create gravitational fields. Einstein, however, in his argument for General Relativity requires that the difference between acceleration due to a gravitational field and mechanical acceleration (being pulled by a rope, e.g.) is a matter of perspective. It is a matter of perspective because we are unable to distinguish between different kinds of acceleration, as described in the quoted passage above. But, if we were to find some way that mass creates a gravitational field, i.e. something special about gravitational acceleration that did not exist for mechanical acceleration, then the difference between acceleration due to gravity and other acceleration could not only be a matter of perspective. If it is not only a matter of perspective then we could no longer have the limitation on our senses. Therefore, as long as this limitation in our senses exists – that we cannot distinguish between different kinds of acceleration – we are theoretically blocked from finding out how mass creates a gravitational field.

The upshot is that by incorporating our limitations into the theory, General Relativity becomes both a theory of physics and also of epistemology. Currently we are now, in part, subjects of the physical investigation into the world, and if General Relativity were to be overturned, then we would have to reconsider the knowledge of our limitations on sensing acceleration. Until that day, General Relativity will be a terminal theory, i.e., there cannot be a more fundamental theory concerning gravity; there is no further answer as to why objects move the way they do.

## Chapter 4

# Evolution Relativized

When studying evolution, similar to when we study motion, we must ask why:

*Why do species change?*

### 4.1 Received Evolution

The theory of evolution states that when organisms reproduce they pass along their hereditary material. This hereditary material determines the traits that the next generation will have. However, the next generation will not be exact copies of the previous generation because the transfer of hereditary material will not create a perfect copy of the parent or parents' hereditary material.

The new combinations of traits and entirely new traits – mutations – that arise will affect how this next generation will interact with the world. Some will help, some will hurt and some will do neither, but over the course of time those organisms with better traits will have greater reproductive success. This is described as Natural Selection:

**Natural Selection:** If in some ecology, all other things being equal, two organisms differ by a trait that will increase the organism's fitness, then the organism with that trait will have greater reproductive success.

Given Natural Selection, an entire species will eventually come to have such a trait because individuals with it will have greater reproductive success and those without it will die off.

#### 4.1.1 Problems

Even if you regard Natural Selection as true, or perhaps even true by definition, this statement of Natural Selection does not explain why an organism will be selected. It says that it will be selected based upon the higher fitness value, but not why the different trait gives the organism a higher fitness value. The fact

that the trait increases the organism's fitness is **postulated** by the definition. Therefore this formulation of Natural Selection does not answer why species change.

Nor does this definition say specifically *how* the selection process actually occurs. We know the outcome is reproductive success or failure, and that this is based upon the fitness of the organism, but how the organism actually gets to the point of success or failure is not specified.

Lastly, this theory of Natural Selection is limited. It works for the most part, but it doesn't apply when the ecology is changing, such as during a disaster. Consider the fitness of the dinosaurs as they are being wiped out by a disaster. This theory of Natural Selection maintains that a dinosaur with better traits will have greater reproductive success, but under these circumstances it is indeterminate if any dinosaur will have reproductive success. Once the environment stabilizes we can revalue fitness levels, but this skips the duration of the disaster. Hence the current theory is limited to ordinary situations: as soon as a rapid ecological change occurs, Natural Selection fails.

## 4.2 Relativistic Evolution

### 4.2.1 Two Kinds of Fitness

To understand Natural Selection we need to understand fitness and how to calculate its value. One way the fitness of an organism can be understood is in terms of how well it will be able to interact with its ecology to acquire what it needs to live and reproduce. The traits of the organism will be crucial as it struggles to survive: every little adaptation or edge that the organism has can be the difference between survival and death. Therefore the traits of the organism determine its fitness.

However, the fitness of an organism is dependent upon its environment. The different situations an organism finds itself in, which are determined by the ecology and chance, will determine its ability to reproduce. For example being fast is meaningless if there is no secure footing to run on. Therefore it is the situation that determines the traits that matter and hence fitness is a function of environmental selection.

At this point it can look as if there are two distinct and incompatible methods for calculating the fitness of an organism: trait based selection and environmental selection.

### 4.2.2 The Equality of Trait Selection and Environmental Selection

Imagine a jaguar out in the jungle. Unbeknownst to anyone, however, his welfare is being carefully monitored by stealthy scientists. Any time the jaguar might be in trouble, be it a lack of food or an unfriendly competitor, the scientists step in and protect the jaguar from harm and do it without being seen.

An independent observer, someone who doesn't know about the scientists watching over the jaguar, might think that the jaguar has an uncanny ability to find food and avoid dangerous situations. He might suspect that the jaguar has excellent ears that can hear danger from very far away and a nose that can smell even the faintest waft of food. He would believe that in the struggle for survival the jaguar was incredibly well adapted.

Ought we to smile at the man and say that he errs in his conclusion? I do not believe we should. We could be in the very same position as the jaguar. We like to think that we have evolved the way we have by struggling and adapting. However, we may have just as easily been assisted by some benevolent but reclusive extraterrestrials. They could be the reason our species has been able to accomplish all that we have, and we would not know.

Regardless of the existence of any such extraterrestrials, the example shows that we cannot tell the difference between struggling and surviving based upon traits, and nature conforming (or disconforming) to our adaptations. It is a matter of perspective to believe either that our adaptations were the cause of our success or if it was the environment that happened to favor us.

### 4.2.3 The Natural Selection Field

Instead of switching back and forth between environmental and trait selection, we can say that both kinds of selection create a field. This field is ontologically as basic as the two kinds of selection and it is what interacts with the individual organisms and environment. The interactions of an organism and the field determines the course of the organism's life, and an ecology's total field is determined by everything in it.

Although every organism and each ecology is unique, none are alien. By looking at similar organisms and similar ecologies, we can use natural history to determine important adaptations and key environmental features. Taken together these features specify the shape of the Natural Selection field of that ecology, which informs us on how an organism or species will interact with their environment.

An organism's overall fitness will determine how great its effect will be in the Natural Selection field. Introducing a species with high fitness into a new ecosystem can cause great changes, whereas introducing a species into an environment that it cannot survive in will barely create a change at all. For example, when humans, with our high fitness, move into a new area, we will profoundly alter that ecology. However, if we bring a flower with us that can't survive the cold nights in our new home, then the flower will die, barely registering any change in the Natural Selection field.

### 4.2.4 General Relativistic Natural Selection

With the existence of the field we can say how evolution acts upon a species. At every moment an organism interacts with a natural selection field created by its surrounding ecology. The constant interaction with the field will gradually

modify the species by benefiting certain individuals and by putting others at a disadvantage.

Insofar as the natural selection field is indistinguishable from the struggle for survival, we will not be able to further analyze why species change: this theory is terminal in the same way as General Relativity. If we could show that the way organisms and species benefitted or were put at a disadvantage by the environment, without regard to the individual adaptations of the organisms, or conversely show how an adaptation increased an organism's fitness without regard to the environment, then an investigation into these specific phenomena could yield insight into why a species changes. However, since we cannot make this distinction, the natural selection field is the final answer as to why a species changes.

Unlike the previous theory, general relativistic natural selection is wider because it is applicable during rapid ecological changes. The prior theory of natural selection relied upon trait based analysis to determine future reproductive success and hence was unable to accurately predict success during rapid change. Relativized natural selection can say that the organisms and species experiencing a disaster (or utopia) are experiencing a change in the natural selection field. This change in the natural selection field manifests as a rapid change in the lives of the organisms. Once the ecological change is finished, then we can revert back to the old notion of natural selection.

## Chapter 5

# Considerations

### 5.1 Fitness and Circularity

Under the prior conception of Natural Selection an organism's fitness was based upon its traits. However, to determine which traits increased fitness the theory relied upon whichever organisms survived. This led to the circular notion of 'Survival of the Fittest', a term Darwin never used, meaning that the fittest survive and the ones that survive are the fittest. The circularity is problematic because it does not tell us anything about which organism will be fittest ahead of time; it is vacuously true.

Under General Relativistic Natural Selection, fitness is defined in terms of an organism's interaction with the natural selection field, which immediately removes the circularity. For instance, an organism who can resist many changes in the natural selection field would have a high fitness. Candidates for this would include organisms that have remained mostly the same for a very long time, such as alligators and sharks. Also included under this scheme are organisms that can survive in many different environments, such as humans and weeds.

Another way to judge fitness in terms of the natural selection field is to look in extreme environments. The bottom of the ocean, far from light, and environments without oxygen are two places that come to mind: the organisms that live in those environments have to be incredibly adapted to deal with the extreme and unusual conditions that the rest of life must avoid.

### 5.2 The Struggle for Survival

The struggle for survival has generally been taken to describe the trait-based competition upon which Natural Selection was based. As I've argued above this is a limited way to view the situation, and I believe it to be more historically motivated than theoretically or empirically driven.

Considering that the environment is a fundamental aspect of how we judge fitness, we can say that the struggle for survival is equally a struggle to find

harmony with the environment. This opposing metaphor is just as valid while using completely different concepts. It is my hope that this new line of analysis will bring more and varied thought to evolution.

### 5.3 Symbiosis and Groups

The prior theory of Natural Selection has no simple answer to why different species live together: it must increase fitness, but the how and why are lacking. General Relativistic Natural Selection makes this easy: the organisms are caught in each other's natural selection field. When two species get their natural selection field's intertwined they end up living in some sort of symbiotic relationship. In a mutualistic relationship the total field for the two organisms together is greater than the individual fields for either, keeping the different species together. In a parasitic relationship the parasite uses the larger natural selection field of the host to its own advantage.

This also yields a simple explanation as to why organisms live in groups: the natural selection field of the group is larger than that of any individual. The group has the ability to change the environment, change the local natural selection field, in ways that individuals cannot. Therefore, even though there will be competition for resources within the same species, this is outweighed by the benefits of living together.