

TIME AND BEAUTY

Why Time Flies and Beauty Never Dies

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Overview

Growing up, I realized that time was passing faster and faster. This feeling persisted. I became so curious that in March 2019 I published a physics-based explanation for why this feeling is so common. My article [1] was the most read in the entire world during that month [2]. The obvious message is that aging is of concern to all of us on the planet. This book is my story of the idea and its reflection in the physics of beauty and usefulness in life.

Time is slipping through our fingers and never comes back. It slips faster as we get older. Have you ever wondered why we feel this way? Have you questioned other perceptions? For example, have you noticed that most of us are attracted to images that are roughly 50 percent longer horizontally than vertically, as shown in Figure 1.1? Beautiful paintings in art galleries tend to be shaped this way [3]. Have you ever wondered why we are attracted to beauty?

Why these common observations? I questioned them, and I want to share with you the thread, the one idea that connects them all. As you begin to see this connection, you will acquire a deeper understanding of the biggest and most divisive enigma in science today: evolution.

Time and beauty are two of our most basic perceptions. They are so common that they are overlooked. Obviously, they

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Figure 1.1 Time slips through our fingers, and beauty is in the horizontal, golden ratio shape of the image (photo: Ben White, @benwhite photograph).

are poles apart. Time is not to be confused with beauty. To paint time is as absurd as to clock beauty.

Different does not mean unrelated.

In this book I show that these two perceptions — the feeling that time accelerates with age, and the attraction of beauty — are both part of the same natural design, in accord with the constructal law¹. They are an integral aspect of the human animal, striving to live and improve along the way. The perceptions of time and beauty owe their origin to the physical configuration of the currents that convey observations to the brain, and to the human tendency to make choices that empower us to live more and more easily.

Time and beauty are physics. In this book, many aspects of the connection between time and beauty are organized under three principal ideas:

¹For a finite size flow system to persist in time (to live) it must *evolve* with *freedom* such that it provides easier and greater access to what flows (to read more, see the books on page 186).

The first is our perception of time and why we feel that time flies faster as we get older. The perceived time is called “mind time,” and it is different from the clock time. The mind time belongs to the individual, the observer, and is a sequence of images — reflections of nature — that are fed by stimuli from the sensory organs.

The rate at which changes in mental images are perceived decreases with age because of several physical features that change with age: the saccade frequency decreases, the body size increases, the pathway degradation intensifies, and so on. The misalignment between mental image time and clock time serves to unify the voluminous body of published observations on evolution as a phenomenon and principle of physics.

Second, beauty attracts because beautifully shaped images are scanned faster by the two eyes. To observe the immediate surroundings and understand them faster is good for life. The book illustrates the main features of image creation and transmission, such as shape, contrast, message, and perspective.

Third, the book puts time and beauty together in order to explain why at the start of the pandemic it felt as if the mind time slowed down. The explanation leads to techniques that each of us can use to slow down our accelerating mind time, and to achieve the feeling that we live longer and more creatively.

Here is a brief run-through of the chapters in the book:

Observations that make us conscious of the passage of time are limitless (Chapter 2). Change is omnipresent, and therefore easy to notice. In fact, animal design is about perceiving the changes in the immediate surroundings that constitute the animal’s “niche”. We breathe at particular time intervals between inhalation and exhalation. We can vary our breathing times if instructed to do so during a pulmonary exam, yet it is natural to breathe at certain intervals that are so natural that we do not think we are performing work as we breathe.

The same holds for blood circulation. Our hearts beat at regular time intervals. We cannot control that frequency, yet it

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varies depending on what the rest of the body and its niche do. The athlete's heart beats faster during the game than on the side lines or in bed at night.

Time and timing are everywhere. We see this in animal locomotion. When you walk or run, you put the right foot ahead of the left after a particular time interval. When you put your right foot ahead, you also swing your left arm forward. The horse does something similar: when its right hind leg moves forward, the left front leg moves forward as well. It's the same for the cat and the mouse. The time step for the cat is shorter, and it is even shorter for the mouse.

Timing is everything, like the firing of the spark plug in an old automobile engine. Timing and fine-tuning do not apply only to mammals. Small birds (such as robins and cardinals) hop less frequently than even smaller birds (such as sparrows and swallows). They are called passerines, from the Latin noun *passer* for small birds. They cling to branches and hop on land. They do not walk like mammals and bigger birds such as pigeons, chickens, turkeys, and ostriches. In order to walk, birds cannot alternate the movement of their "arms" in the same way as quadrupeds and bipeds do. Instead, they thrust their head in synch with each step so that the body's center of mass is always as far in front as possible, helping the body to move forward more quickly. Notice how the pigeon walks and bobs its head, just like the chicken.

Humans perceive *change* in the observed surroundings, not 'clock time'. Perceiving change is so common that each one of us grows up confident that tomorrow will be different than today. The prehistoric *homo* perceived change with moving eyes, not dead scenes with motionless eyes. This is how he knew that "now" is different from "before" and that the future will be different from the present. Later, as language developed, he recorded this most common of all observations in words such as *now*, *before*, *next*, *past*, *present*, *future*, *time*, and the passage of time.

Why do we tend to focus on the unusual (the surprise) and not on the ever present? This book unveils the physics behind this tendency. The reason is that the time measured by a clock is not the same as the time perceived by the human mind. The mind time is a sequence of images, or reflections of nature, that are fed by sensory organ impulses. The rate of changes in mental images decreases with age because, as noted already, several physical features change with age: saccade frequency, body size, and pathway degradation. These variations have been well documented in physiology, and they are grouped together as a single phenomenon in Chapter 2.

Beautiful paintings, bas-relief art, and facades of buildings are typically shaped like Figure 1.1, longer horizontally than vertically. They look beautiful for two reasons: the observer has two eyes aligned horizontally, and the eyes *scan* the observed image in short, sudden motions (saccades). Scanning occurs in both vertical and horizontal directions. Repeated scanning, the movement that causes the perception of change in the observed image, is the physical process that underpins the perception of time.

Chapter 3 shows that an image is scanned the fastest (vertically and horizontally) when its two-dimensional shape has an aspect ratio (length/height) of approximately 3:2. Faster scanning means faster understanding of the immediate surroundings. People are unwittingly attracted to such an image because it makes life safer and easier. To move out of danger and to find food, shelter, and mate, faster grasping is essential. This applies to all animals with vision, whether runners, fliers, or swimmers.

Scanning is a movement that unites many features of human life. We scan the earth with our feet, vehicles and communications. Unwittingly, we cover the earth with modular constructs of inhabited areas (block, city, state) shaped such that each area is covered (along and across) the fastest and most economically, just like the human field of vision.

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The connection between easy understanding and easily scanned (beautiful) images serves as the physical basis for cognition. Beauty continues to drive and improve cognition. It is precious and indispensable to life and industry, be it art or fashion.

Beauty means attractiveness, the feeling of being drawn to what you see, hear, smell, and touch. The “contrast” present in an image facilitates perception tremendously (Chapter 4). The sharp contrasts between bright colors, and between dark and light shades, are what triggers the impression of change as the eyes scan the image. The sharp differences, like the ruts in the road, shake both vehicle and driver. They are noticed and remembered.

Chapter 4 illustrates how the presence of contrast accounts for several illusionary impressions in the observer’s mind. Illusions tend to occur so as to enhance the contrast between regions that touch, when in fact each region is painted uniformly with its own shade. To accentuate the interface, the shade of each region appears nonuniform in the vicinity of the interface. As Harry Houdini put it, “What the eyes see and the ears hear, the mind believes.”

Illusions take place while the mind organizes the newly received image among previous images that are already sorted and stored. This is the mechanism of perception. I think of it as the Tetris game, in which a successful move takes place when a new brick falls into a waiting gap, so that the wall of bricks becomes bigger and stronger.

How the Tetris player rotates the new brick to make it fit in the waiting gap is not necessarily how the brick was actually oriented before it arrived. The difference between the two orientations can create the illusion that the new brick was added before it arrived. That is why perception is personal, belonging to the individual. To be in a situation (*in situ*, at a site, position,

place, time) is to be in a changing image that you perceive as your “surroundings.” At the same time, your neighbors perceive the changing image as their own surroundings, with you in the image that they perceive.

The world measured, modeled and ultimately predicted by physics is the world of perceptions, a category of *mentation*. The phantasms and abstractions reside merely in our *descriptions* of the behavior of that world, not in the world itself.

Niels Bohr

In this book I ask why the mind “tries” to make sense of a new input. Why is there a natural tendency to organize the fresh input to make it fit among past receptions? The answer that comes from physics is one, and it is general: empowering the individual with speed and clarity of thought, understanding, decision making, and movement on the earth’s surface. The same answer holds for the other “disparate” perceptions detailed in this book, from time and beauty to shape, message, perspective, and dreams.

The shapes that attract us are diverse, but not many. Chapter 5 shows that in addition to the golden ratio rectangle (Figure 1.1), prevalent in nature and the human realm are the conical shapes (e.g., hourglass, sand pile, termite mound, teaspoon heaped with sugar), round cross sections and tree architectures in flow channels, and the “convergent” shapes of boats with sails, airplanes, helicopters, pyres, pyramids, and bird-foot-shaped supports.

The perceived image conveys an idea to the viewer. The concept of “idea” comes from the ancient Greek *idein*, which means seeing with the eyes of your mind. Once grasped, the idea is out of the page. It cannot go back. If the viewer reproduces the idea (the mental viewing) and presents it as his own,

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then that is a stolen idea. Chapter 6 is an illustrated course on how to distinguish between the remake of an idea and the original. The detective work must be done by human eyes because pictures do not lie.

Nature is not a gallery of two-dimensional objects, as in the many illustrations displayed in this book. The third dimension of an object is the “depth” perpendicular to the viewed plane. This is perceived in perspective, which means the view as you look *through* the image. Chapter 7 graphically teaches the method of linear perspective due to Filippo Bruneleschi, a central figure of Renaissance architecture. The method comes from the idea that the animal mind evolved to acquire a simple rule of perceiving and understanding “depth”: objects that are near look big, and similar objects that are far look small. The mind compares the big and the small and understands the depth of the image and how close the danger is.

Perceptions of time and beauty are essential in art and science (Chapter 8). The history of technology is recorded as a select parade of objects (devices, inventions) aligned in a particular direction with the passage of time. The same can be said of the history of civilization, for which the history books show us images of much bigger objects: edifices, roads, bridges, and aqueducts. The history of science is its own parade of images, from antiquity to the present. Yet, hidden under the feet of this marching column is the secret of the direction of the march:

In the beginning, the objects of arithmetic and geometry were one-dimensional: lines, segments, size comparisons, and the line axis of numbers. Later, the one-dimensional objects were joined by two-dimensional objects (plane geometry), and then by three-dimensional objects (solid-body geometry). The direction has been toward liberating the form (drawing, design) to exhibit it in more dimensions.

The direction has been toward greater freedom, from one dimension to two and three. More dimensions in designs imply

greater complexity in the population of designs. The same evolutionary direction is discernible in the history of art, from pre-historic dots and line markings on cave walls to paintings on the same walls, all the way to the paintings and photographs of the modern era. Then came three-dimensional art, from bas-relief in ancient Middle East to Greek sculpture and, two hundred years ago, French descriptive geometry. One hundred years ago, a new kind of three-dimensional art arrived — the moving picture (cinema) — in which the new dimension was time.

Slow time becomes fast when every train of images (or any activity) repeats itself the same way many times. The opposite is true as well. In April 2020, when the coronavirus lockdown began, many people felt that time had slowed down. They talked and wrote about it. The time slowed down because we were forced to experience new things. The new mode of living brought back elements from before the industrial age. We stayed home, walked around, and got to know our neighbors.

Time slowed down in synch with our own movement. This, however, did not last long. Two weeks later, the new life stopped being new. It had become its own routine. Without warning, time had regained its original fast pace. In the final chapter, I invite the reader to use lessons from the pandemic in order to control the speed of perceived time. For example, to slow down my time, I do several things. I keep my eyes open. I carry a paper calendar on which I see the days of the month, and cross one at a time. I see what lies ahead and what is behind. I write by hand and draw by hand.

I tend to do the kind of work that is not repetitive, not routine. One who is engaged in creative work, such as research, writing, and design, enjoys this advantage. I value each day as if it were my last one. One hears such advice when discharged from the hospital. During unusual events such as crises, fresh ideas, new art, or an exciting football game, we pay closer attention to the changes that occur in the images in front of our eyes,

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and consequently the brain records more changes per unit time — that is, more changes than when we are bored. The unusual makes us feel that time has slowed down.

Geographical location has an effect on how we perceive the passage of time. The effect of location is due to human activity (movement, speed, fuel burned, wealth, economy, advancement), which is distributed nonuniformly on the landscape. Imagine moving from North Carolina to New York. Human activity is more intense, faster, and full of change in New York.

The moral of the story told in this book is that although scientists may have contemplated aspects of time and beauty separately, it is fun to understand them together, and to predict them. It pays to walk against the marching crowd. That way, you see many more changes than when you are inside the crowd, moving at the same speed and in the same direction as everybody else.

Time and beauty are so obvious and “disconnected” that to put them together in a book of physics requires daring. This book is not only about why these human perceptions are correct and predictable on the basis of physics, but also about why they share the same cause, the same physics. This, the surprising and very simple answer, is the reward to the thinker who questions and has the courage to speak up. The courage to question and to go against the tide is rare and valuable, especially today in the era of big data and “knowledge industry”. For me, the questioning learned growing up and at MIT is like what I learned in basketball: you can’t beat the training. You can’t forget it, that’s who you are, that’s what you think, that’s what you do.

Understanding the physics of human perceptions (time, beauty) brings us closer to the physics of how our mind flows and functions. It ushers the science of form and consciousness. There is physics behind all human preferences. Physics is the human urge to be fast, wise, safe, economical, and all-knowing and to live longer. We learn to get by, we polish, and we keep

what works. This, by the way, is evolution as physics. The river basin does it, and so does the urban traffic. We all do it.

Perception is the most empowering feature of the human animal design: vision, hearing, smell, taste, and touch.

The story of science offered in this book is a human story. The history is kept close to the narrative. The physics in the story was first published in peer-reviewed scientific journals [1, 3]. My unusual path in life is intertwined with the history of science and the main plot, which is the emergence of the discipline of the physics of evolution, form, and consciousness.

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