Reviews

This outstanding book presents an impressive collection of surprising facts about the brain, the miracles it creates, but also the mistakes it makes. The author explains that the positive achievements and negative outcomes are produced by conscious and subconscious models that the brain constructs and operates. This formulation is consistent with the most recent results of brain science. From this concept, he is even able to derive philosophical conclusions such as "the concept of free will is nonsensical." Fascinating!

—Martin Grötschel, mathematician and former President, Berlin-Brandenburg Academy of Sciences and Humanities, Germany

A novel way to look at the human mind. Magic, Error, and Terror is a good title for this insightful analysis of the mind based on his models of the conscious and unconscious. I learned from Wittgenstein that if you cannot give examples in an abstract discussion, you are talking nonsense. I like this book because the author gives a lot of examples from real life situations. For example his discussion of fatigue and panic attacks and their treatment lets you have a grip of the magic of his models. His analysis of medications given to postmenopausal women and religion as examples of errors and terrors of models are enlightening. The book is written in a clear and accessible fashion. I highly recommend it.

—K. T. Fann, former professor of philosophy, York University, Canada. Author and editor of several books on philosophy

A veritable scholarly "page turner!" Starting with the very first chapter of the book the author captures your attention, building anticipation for the chapters to follow. This book is concise, clearly written and opens our understanding to new ways of interpreting reality. It is both hopeful and terrifying! A truly engrossing piece of work!

—Michele K. Steigleder, Ph.D., Clinical Psychologist

Also by Klaus Truemper

History

The Daring Invention of Logarithm Tables
The Construction of Mathematics

Technical

Logic-based Intelligent Systems
Effective Logic Computation
Matroid Theory

MAGIC, ERROR, AND TERROR

HOW MODELS IN OUR BRAIN SUCCEED AND FAIL

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Contents

1

Introduction

The human brain[1] has enabled mankind to

- create bountiful harvests
- design powerful computing machines
- conquer diseases once thought incurable
- replace body parts
- fly to the moon and back

We could go on and produce a long list of near-miracles. What made this possible? Two factors come to mind.

- The brain develops its basic capabilities in infancy and later changes itself as the need arises.[2] The end effect is an incredible performance of complicated tasks—like the processing of images and language—that our fastest computers can't match.
- The brain builds and stores in its various parts complex *models* that represent features and processes not just of the world, but also of the body.[3] These models are essential for interaction with the world and management of the body.[4]

All this by an organ weighing less than 4 lbs.[5]

Stephen Hawking's book *The Grand Design*[6] formalizes the concept of models inside the brain.

It declares that some of the models are stashed away in the brain below the level of consciousness. They are *subconscious models.* Their defining characteristic is that we aren't aware of them in our daily lives.

Other models reside at the level of consciousness. They are sometimes written down and stored in books and technical journals, or more recently on the Internet. They are *conscious models* since they are easily accessible and we can readily describe them. They include conceptual models such as Newton's model of gravity and the Big Bang theory of the universe's origin.

The idea of subconscious and conscious models is related to, but not the same as, the notion of intuitive and deliberative thinking.[7]

Yes, subconscious models sometimes produce results that appear at the level of consciousness as intuition. In fact, one could characterize intuitive thinking that way. Also, conscious models are part of deliberative thinking.

But the concept of subconscious models encompasses much more. Let's rank them according to the degree of difficulty with which they can be accessed by conscious thought.

At one end of the scale are subconscious models that can be accessed with a bit of effort. For example, we may become fearful when we see dogs. Thinking about that reaction and searching our memories, we recall that a dog bit us decades ago.

Next are models we cannot identify readily, but are able to discern by significant effort. An example are subconscious models discovered during psychotherapy.

Finally, there are subconscious models that are essentially inaccessible.[8] An example is the subconscious processing of visual information, such as identification of the boundaries of objects. In a

more complicated case, a subconscious model determines that ongoing, strenuous physical activity would damage the body if continued not just for hours but for days. The model output triggers a feeling at the conscious level that rest is required and one needs to sit down.[9]

You may be surprised that we use the single label "subconscious" for such a variety of models. The alternative would be a classification using several terms. This would be a formidable task, given the complexity of the possible cases. It also would invite futile discussions whether specific cases have been appropriately classified.

Our single label avoids such debates and allows us to focus on the role, interaction, and impact of these models in various settings.

For the same reason, we generally won't attempt to specify where in the brain the various subconscious and conscious models reside and how communication between models is accomplished.

In the night sky, some bright points of light seem to always move together, while others wander individually. Extensive research carried out over centuries resulted in a conscious model that not only classifies the two types of lights as stars and planets, but predicts with high precision their movement.[10] In particular, the model predicts that the planets move around the sun in elliptical orbits.

The results of the model are often cited as if they were facts of the world: The orbits of the planets around the sun are then claimed *to be* elliptical.

But that is not the case: The planets influence each other in ways that have proved to be mathematically intractable: While approximate formulas predict the movement for limited time intervals, we can only guess what will happen long-term.[11]

The example isn't an unusual case of model interpretation: We conflate model output with facts of the world on a huge scale.

Indeed, much of what we decide and do is based on this assumption. Appropriately, in the book *The Grand Design* this conflation is called *model-dependent realism*.[12]

Here are the key components.

- The brain uses a large variety of subconscious and conscious models to cope with the world.
- The brain declares the output of these models to be facts.
- The brain bases decisions on these supposed facts and considers them valid since they are, well, fact-based.

Fortunately for us, the declaration of model output as fact mostly has good if not wonderful consequences. At times the results look like magic. Examples are today's computers, communication devices, the Internet, and the Global Positioning System (GPS).

The key word in the preceding paragraph is "mostly." There are exceptions where model-dependent realism prevents important developments, causes harm, or results in utter destruction and terror.

We can prevent such negative or even horrific results when we acknowledge that we are dealing with model output and not with facts, and then modify or replace undesirable models by others. That way the conflation of model output with facts no longer causes harm.

The prevention invariably entails that we first acknowledge that we are dealing with model output and not facts. After that step we are ready to improve or replace models.

We may adjust or replace not only conscious models, but also subconscious ones. Many psychotherapy interventions can be viewed as replacement processes of the latter type.

In the chapters that follow, we look at diverse scenarios where model-dependent realism produces desirable results, or harm, or even terror. We also see how a shift to different models eliminates some cases of the latter two kinds.

We say "some cases" since an outcome may be the sum of effects produced by a model residing in millions if not billions of brains of the people of an entire country or even the world. In that case, us changing the model in our brain has no noticeable impact.

Examples are the human overpopulation of the earth created by the drive of most couples to have babies, and the destruction of the environment and mass extinction of animals due to the human urge for ever-increasing consumption of resources.

A great many books propose new models that, if installed in most brains of the world, would change these overall outcomes. But the books fall woefully short on realistic recommendations how people can be convinced to adopt these models. Evidence of failing installation attempts are the fruitless debates about the wholesale destruction of the earth's lands and oceans, and the mass extinction of animals. If we were to ask the dolphins, whales, and elephants about this, they would say that the earth suffers from a pandemic infestation by humans.

We will not add to these proposals here since we are rather pessimistic about the installation attempts. We just hope that humanity will eventually find a way to avoid looming self-destruction.[13]

The book consists of three distinct parts that cover a kaleidoscope of cases. They demonstrate the universal role of subconscious and conscious models in our lives.

- Part I tells how some subconscious models can be changed. It is by no means self-evident that this can be done, since by definition subconscious models are not easily accessible by conscious thought if at all. The examples cover psychotherapy, the notion of fatigue, the control of breathing, optimal motion, relaxation, and training in general.
- Part II covers deceptive conscious models of medicine, economics, politics, and religion. We focus on deceptive conscious models since there is a huge literature on successful ones.

- Part III uses conscious and subconscious models to investigate statements of philosophy. In particular, we look at the question whether we have free will.

Even if you are not so fond of philosophical discussions, you may still want to look at the first two chapters of Part III since they describe a method for identifying nonsensical questions and statements. We use it almost daily to separate useful grain of news reports from chaff.

As you read the chapters, you surely will come up with more ideas about subconscious and conscious models; their impact; and how to create, modify, or replace them. For example, you might consider addiction to be an instance of deceptive subconscious models, and view treatment as modification of such models. Part I contains relevant material for such an investigation.

Stimulating such thoughts is another purpose of the book.

Let's get started with Part I: How can we modify subconscious models?