

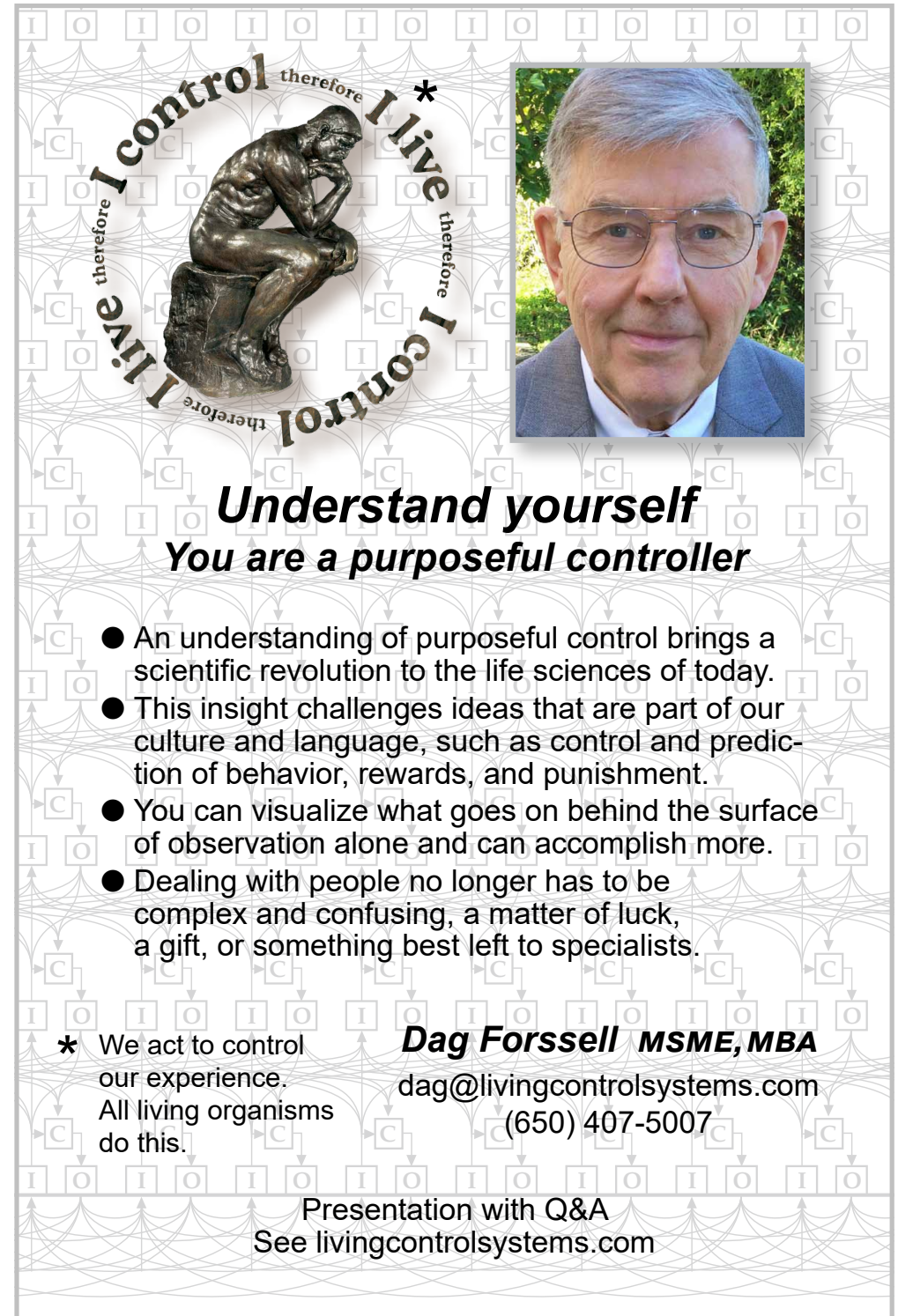
This pdf holds a preview of Dag Forssell's presentation on scientific revolutions in general and one underway in psychology and life science in particular.

Slide and script on each page.

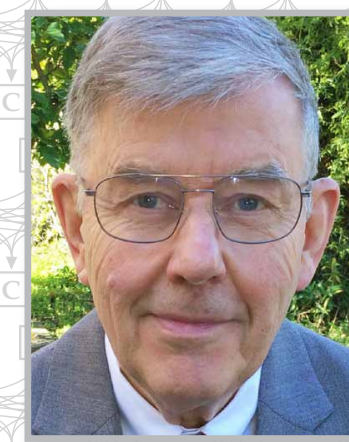

Email address in the ad to the right.

Q&A to follow Dag's presentation.

Dag lives in the San Francisco Bay area



I live therefore I control * **I live therefore I control**



Understand yourself
You are a purposeful controller

- An understanding of purposeful control brings a scientific revolution to the life sciences of today.
- This insight challenges ideas that are part of our culture and language, such as control and prediction of behavior, rewards, and punishment.
- You can visualize what goes on behind the surface of observation alone and can accomplish more.
- Dealing with people no longer has to be complex and confusing, a matter of luck, a gift, or something best left to specialists.

* We act to control our experience.
All living organisms do this.

Dag Forssell MSME, MBA
dag@livingcontrolsystems.com
(650) 407-5007

Presentation with Q&A
See livingcontrolsystems.com

Relax...

**This presentation, numerous
tutorials, papers, and other
resources are free downloads**

I want to tell you about an emerging scientific revolution, caused by an idea that explains much of what you experience.

My objective today is to provide some context and expose you to this development: to give you a glimpse of insight that is available to you. There is no need for you to understand it all right away, Get the whole story from tutorials, papers and resources that are free downloads, plus a growing body of literature.

The fundamental insight is that all living organisms are purposeful control systems. We are purposeful beings. We want something, and we make it happen, whether instantly or long-term. The physical phenomenon that explains how purpose works is control.

v.livingcontrolsystems.com

At this point I have spent 30 years as a student and advocate of what amounts to a new, solid foundation for psychology and the life sciences of the future.

This promises better understanding and harmonious relationships all around.

The claim that this fundamental insight causes a scientific revolution is upsetting to

some and preposterous to all—unless you understand that entire sciences have been upended by new insight and had to start over several times in the past.

Understand yourself

You are a purposeful controller

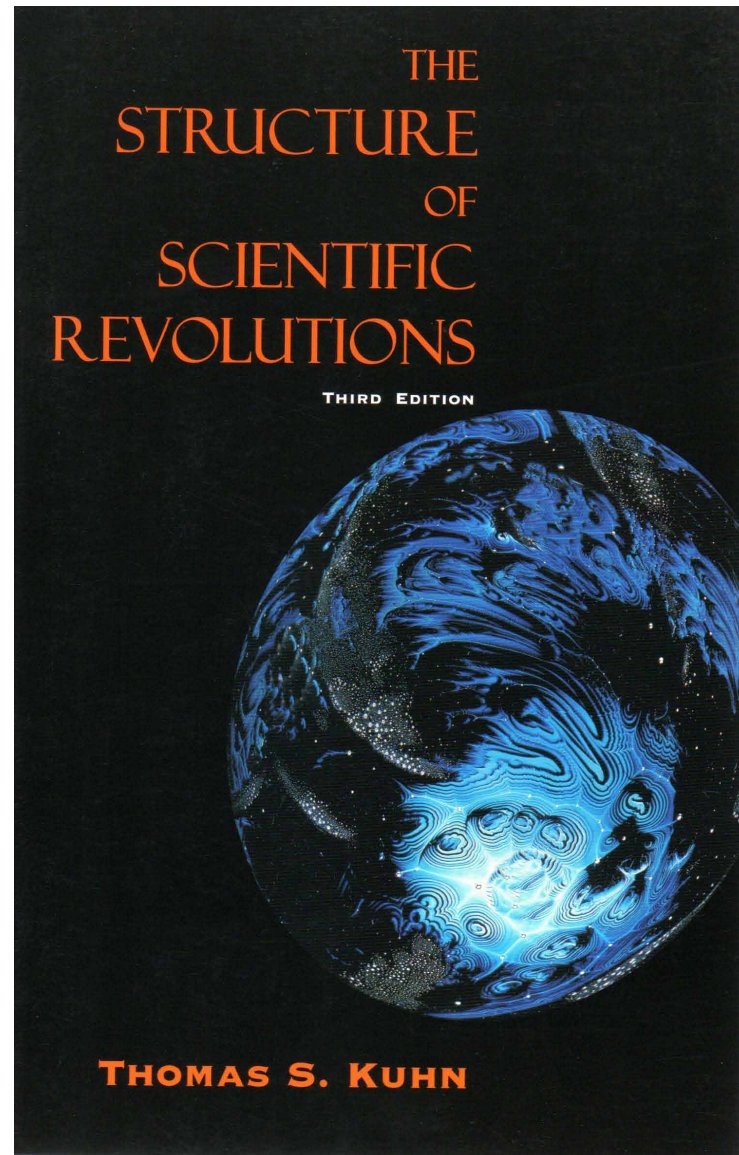
An introduction to

Perceptual Control Theory (PCT)

A new foundation for the sciences of life

Dag Forssell, MSME, MBA

© Dag Forssell 2019



livingcontrolsystems.com

So, what is a scientific revolution? Thomas Kuhn showed how progress in a science is not always a matter of a steady accumulation of facts, what he called 'normal science'.

Once in a great while somebody discovers a fundamentally different explanation. This may happen when the current science is in trouble, as Kuhn

discusses in chapter seven of his seminal work *The Structure of Scientific Revolutions*. Kuhn introduced the concept of a paradigm—the body of understanding that dominates a science at any one time.

He describes a typical scientific revolution: First, people invested in the current paradigm resist the new idea. No surprise there! Control systems, like all of us, resist disturbances to existing understandings.

Second, people who come later embrace the new idea on its merits. Third, the old guard dies off, and fourth, textbooks are rewritten. The old paradigm is forgotten.

Preface	vii
I. Introduction: A Role for History	1
II. The Route to Normal Science	10
III. The Nature of Normal Science	23
IV. Normal Science as Puzzle-solving	35
V. The Priority of Paradigms	43
VI. Anomaly and the Emergence of Scientific Discoveries	52
VII. Crisis and the Emergence of Scientific Theories	66
VIII. The Response to Crisis	77
IX. The Nature and Necessity of Scientific Revolutions	92
X. Revolutions as Changes of World View	111
XI. The Invisibility of Revolutions	136
XII. The Resolutions of Revolutions	144
XIII. Progress through Revolutions	160
Postscript-1969	174
Index	211

© Dag Forssell 2019

The best known example may be the Copernican revolution. Up until five hundred years ago it was obvious to everybody that everything in the heavens goes around the earth. The astronomer Ptolemy created a mathematical model in support of this idea around 150 AD and this descriptive science ruled astronomy for 1,300 years. The basic perspective of this science was the intuitively obvious one: looking at the heavens from the earth, describing what you see, and guessing explanations.

When Galileo promoted Copernicus' idea that the earth is one of the planets, spins on its axis, and goes around the sun, experts were upset because this idea challenged dogma that was important to established institutions. The basic perspective of Copernicus' idea is far from intuitively obvious. You have to imagine a solar system, where earth is just one part, imagine this system in motion, and compare the result with observations. This approach yields predictions that can be tested.

This fundamental insight turned the scientific applecart upside down.

To silence Galileo's heresy, the experts sentenced him to house arrest for life.

But students who came later, who were at liberty to compare and choose, embraced Copernicus' generative theory because it explains so much better.

When you have a descriptive science with just-so explanations, and someone comes up with a physical mechanism that can explain what you observe, and this explanation passes every test you can throw at it, a scientific revolution gets underway.

The science turns from descriptive to generative, meaning that what you observe is generated by the postulated unseen mechanism that operates under the surface.

Note that what changes with each scientific revolution is your in-depth understanding of what is going on, not necessarily how things appear, phenomena you experience, chemical formulas, proven engineering practice, or human wisdom, though you will be better able to distinguish between good and bad practices. In the case of astronomy, heavenly bodies continue to appear to revolve around the earth, but without the correct idea of the solar system, space travel would have failed miserably.

What also changes is what you can predict in new circumstances. Much progress has been made in all sorts of technologies down through the ages by “cutting and trying”, or “trial and error”, simply trying new ways of doing things and seeing what happens, but engineering feats such as the Golden Gate Bridge requires the ability to predict how things will perform in entirely new circumstances.

Descriptive, soft, science is not enough. You need generative, hard, science.

My talk today is about psychology and life science progressing from being descriptive, where a study yielding 60% correlation between this and that observation is impressive, and starting over based on new, fundamental insight, and evolving into generative, hard, science, where you expect agreement to the limits of measurement every time.

I found out about the idea that living organisms are purposeful control systems because I became curious about what makes people tick.

I grew up in Sweden, got a degree in mechanical engineering, married my sweetheart and together we emigrated to the US.

When Christine turned to direct sales of health products, I joined her for training seminars.

**SEE
YOU
AT THE
TOP**



Zig Ziglar in action

That was my first exposure to self-help literature and motivational speakers.

I wanted insight to help us build a business together, so I began to study sales, public speaking, character education, self-esteem, listening skills, and even Total Quality Management.

I thought a book or program was worthwhile as long as I found an idea or two that made sense to me.

Ten years into my quest for understanding, I hit the jackpot.

I found this book by Bill Powers that spells out how our nervous system works. The title is *Behavior: The Control of Perception*. What this means is that the reason we behave is to perceive what we want to experience.

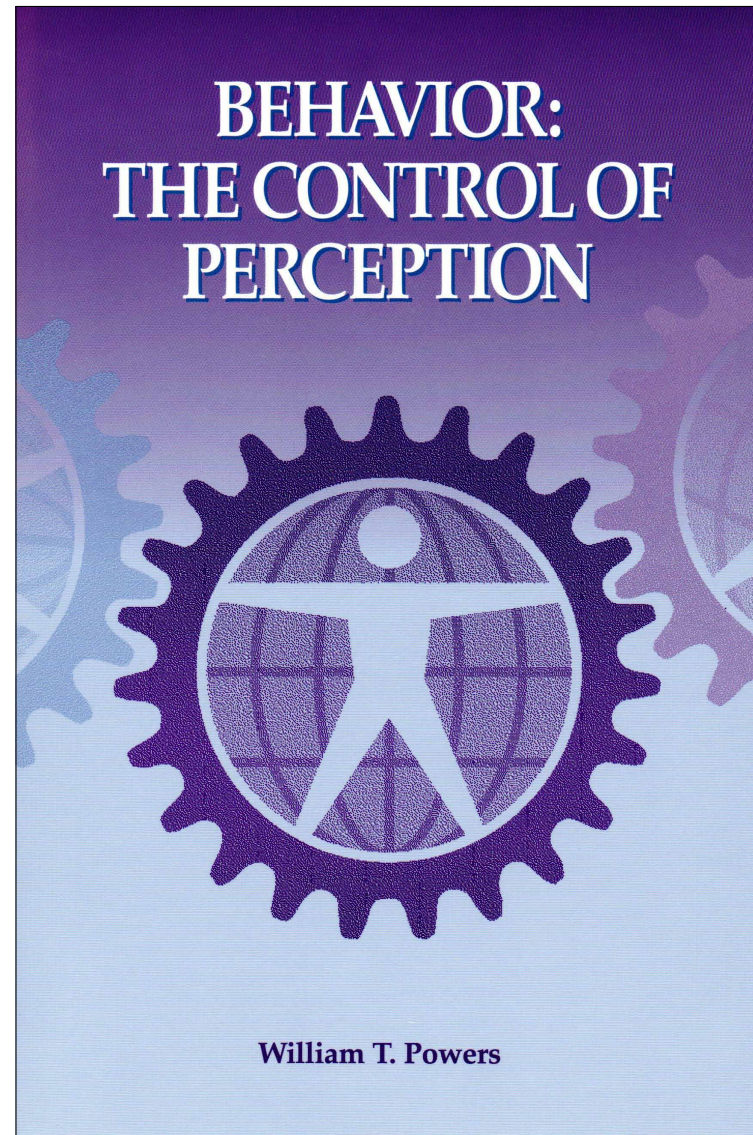
The idea is called Perceptual Control Theory (PCT), because we control our perceptions by means of our actions.

Most of the time we don't even notice our actions, because our attention is on the goals that our actions accomplish for us. Our actions influence our environment so we perceive what we want at the time and under the circumstances.

Consider driving. You turn the wheel and press the pedals to get where you want to be.

Your actions along the way are completely automatic—whatever it takes, moment by moment, to get what you want to perceive right then, as your circumstances change unpredictably.

This means that we control our perceptual INput, NOT our action OUTput. We do NOT control our behavior; we *USE* our behavior to control our perceptions.



livingcontrolsystems.com

You will notice that this is the opposite of psychological science, where the holy grail long has been the prediction and control of behavior. When it was published, some experts said that this book is nothing new; we already know

that perception controls behavior. The opposite of what the book says! This is understandable. All of us strive to fit new information into what we already know, even if we have to change it in the process!

Others took Powers' idea as they understood it, tweaked it so it fit the current paradigm and published their own distorted versions, which were then cited in the literature. Scientific revolutions can get messy and take a loong time!

The Secret of the Great Machine	v
Figures	x
Preface	xii
1. The Dilemmas of Behaviorism	1
2. Models and Generalizations	11
3. Premises	21
4. Feedback and Behavior	41
5. The Control-System Unit of Organization	57
6. A Hierarchy of Control Systems	70
7. First-Order Control Systems: Intensity Control	81
8. Second-Order Control Systems: Sensation Control or Vector Control	98
9. Third-Order Control Systems: Configuration Control	114
10. Fourth-Order Control Systems: Control of Transitions	129
11. Fifth-Order Control Systems: Control of Sequence	137
12. The Brain's Model	148
13. Higher Levels	155
14. Learning	179
15. Memory	207
16. Experimental Methods	233
17. Emotion	252
18. Conflict and Control	262
Appendix: Control System Operation and Stability	285
Glossary	296
Bibliography	301
Index	303
End Papers	312

© Dag Forssell 2019

Powers' fundamental insight is truly revolutionary.

The basic perspective of today's dominant paradigm is intuitively obvious, looking at organisms and their behavior from the OUTside, describing what you see, and guessing explanations.

The basic perspective of Powers' idea is to study organisms and their behavior from the INside.

One way is careful introspection. When observing others, you visualize a control system, guess what the organism is controlling for, apply disturbances to that, and observe action to see if you guessed correctly—that is, whether the organism resisted the disturbance or not.

Just like the perspective of the solar system led to a new, testable astronomy, Power's perspective leads to a new, testable science of life. For sure, Powers' idea turns today's scientific applecart upside down.

To put it yet another way:

We don't DO our actions. Our behavior is not what is of interest because action is automatic given our wants and circumstances. We DO create and control our experiences, our perceptions. Our perceptions are what we care about and pay attention to, but they are invisible to anyone other than ourselves.

When experts first come to understand what PCT is about, they often get very upset because this insight challenges dogma and scientific methodology that are important to academics today, as well as ideas that are part

of our culture and language, such as prediction and control of behavior, rewards, and punishment, as well as the idea that the brain issues commands to our muscles. You too may get upset if you are invested in the current paradigm. Then again, if you are not, you may find it exciting that a fundamental, universal explanation is available for you to explore.

In any case, you have lived a lifetime in the current paradigm, which pervades our culture and language with just-so explanations. Kuhn shows that scientific revolutions are challenging for people who live in the current paradigm. You have to enter the new paradigm to get a fresh perspective on the current one. That is a personal challenge of the highest order.

The science of psychology features numerous competing theories. It suffers from *The Toothbrush Problem*. Walter Mischel, then President of the Association for Psychological Science, put it this way:* “Psychologists treat other peoples' theories like toothbrushes—no self-respecting person wants to use anyone else's.”

One reason for this chaotic situation is that in the life sciences there are no universal, unifying basic functional principles, no laws of nature, to inform theorizing.

The explanatory power of Perceptual Control Theory is awesome and some academics, who are at liberty to compare and choose, are already embracing it, developing and teaching effective applications to psychological problems. Several professionals reported on their progress at the recent annual PCT conference at Manchester University in England.

* In his presidential column of the APS Observer (2008)

When you study PCT, you learn what control is and how it works. You understand how control gives rise to conflict or cooperation, depending on what individuals want and how they interpret their experience. When you understand PCT, dealing with people no longer has to be complex and confusing, a matter of luck, a gift, or something best left to specialists.

When I discovered PCT, I learned that we are all controllers, and that when we try to control others we easily create conflict. With hindsight, I wish I had understood the structure of hierarchical PCT when I was made engineering manager. I think I would have been much better at exploring where my associates were coming from, at reaching agreement on common goals, and could have been more effective.

Along the way, I have read numerous articles that say most people hate having to manage others; that management training of various kinds is ineffective and that the typical remedy is more management training. There is much for us to discuss about the consequences of our ignorance when it comes to understanding ourselves and dealing with others.

Controlling our perceptions is all we ever do. As I control for standing upright before you, I rapidly change what I want to hear myself utter, loud enough to reach the back of this room, and my nervous system just as quickly makes it so.

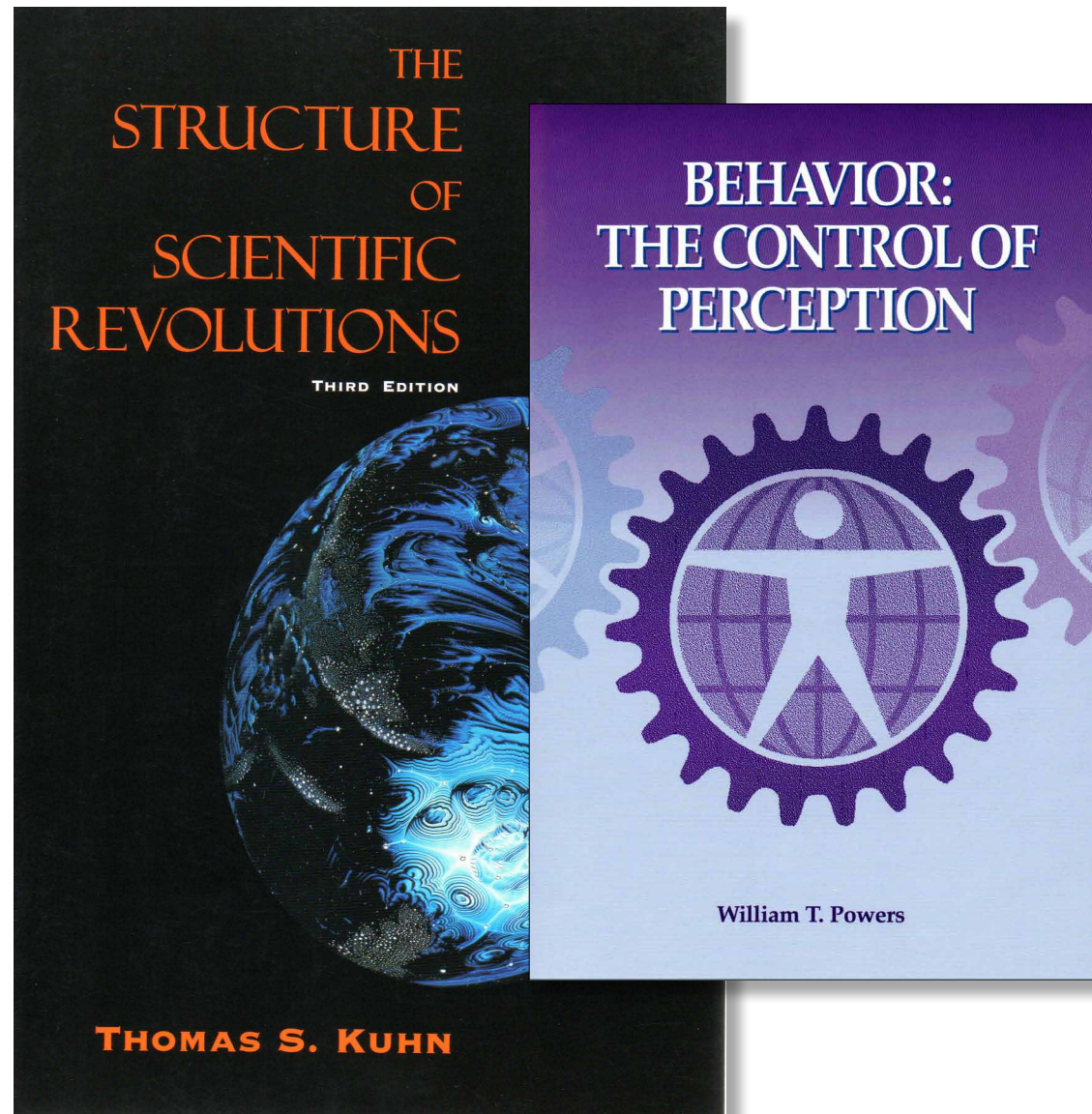
Control is a ubiquitous natural phenomenon. Control at the level of DNA is what makes it possible for plants and animals to replicate generation after generation, and whenever you act to make things just so, you are controlling.

But even though control is the way all living things operate everywhere—inside of us and all around us—we are all blind to it unless we understand how it works.

Engineers have understood how control works since 1927, when Harold Stephen Black, an American electrical engineer, revolutionized the field of applied electronics by inventing the negative feedback amplifier, a control device. To some, his invention is considered the most important breakthrough of the twentieth century in the field of electronics, since it has a wide area of application.

Today, we are surrounded by control devices, doing work humans used to perform. Engineers understand how control works and build capable robots, but most life scientists, while they may have a general sense of control, and use some of the engineering terminology, do not yet understand how this very simple phenomenon works.

Bill Powers' genius is that he figured out how to understand control in living organisms.



The Secret of the Great Machine	v
Figures	x
Preface	xiii
1. The Dilemmas of Behaviorism	1
2. Models and Generalizations	11
3. Premises	21
4. Feedback and Behavior	41
5. The Control-System Unit of Organization	57
6. A Hierarchy of Control Systems	70
7. First-Order Control Systems: Intensity Control	81
8. Second-Order Control Systems: Sensation Control or Vector Control	98
9. Third-Order Control Systems: Configuration Control	114
10. Fourth-Order Control Systems: Control of Transitions	129
11. Fifth-Order Control Systems: Control of Sequence	137
12. The Brain's Model	148
13. Higher Levels	155
14. Learning	179
15. Memory	207
16. Experimental Methods	233
17. Emotion	252
18. Conflict and Control	262
Appendix: Control System Operation and Stability	285
Glossary	296
Bibliography	301
Index	303
End Papers	312

www.livingcontrolsystems.com

© Dag Forssell 2019

In 1973, when Powers' work was published, Kuhn had this to say:

"Powers' manuscript, [title], is among the most exciting I have read in some time. The problems are of vast importance, and not only to psychologists;

the achieved synthesis is thoroughly original; and the presentation is often convincing and almost invariably suggestive."

As I said: we are all blind to control unless we understand how it works.

When scientists study living things without understanding control and without realizing that they are in fact studying living control systems, they use the scientific method, meaning that they apply stimuli and look for responses. It is also called cause and effect or independent variable, dependent variable.

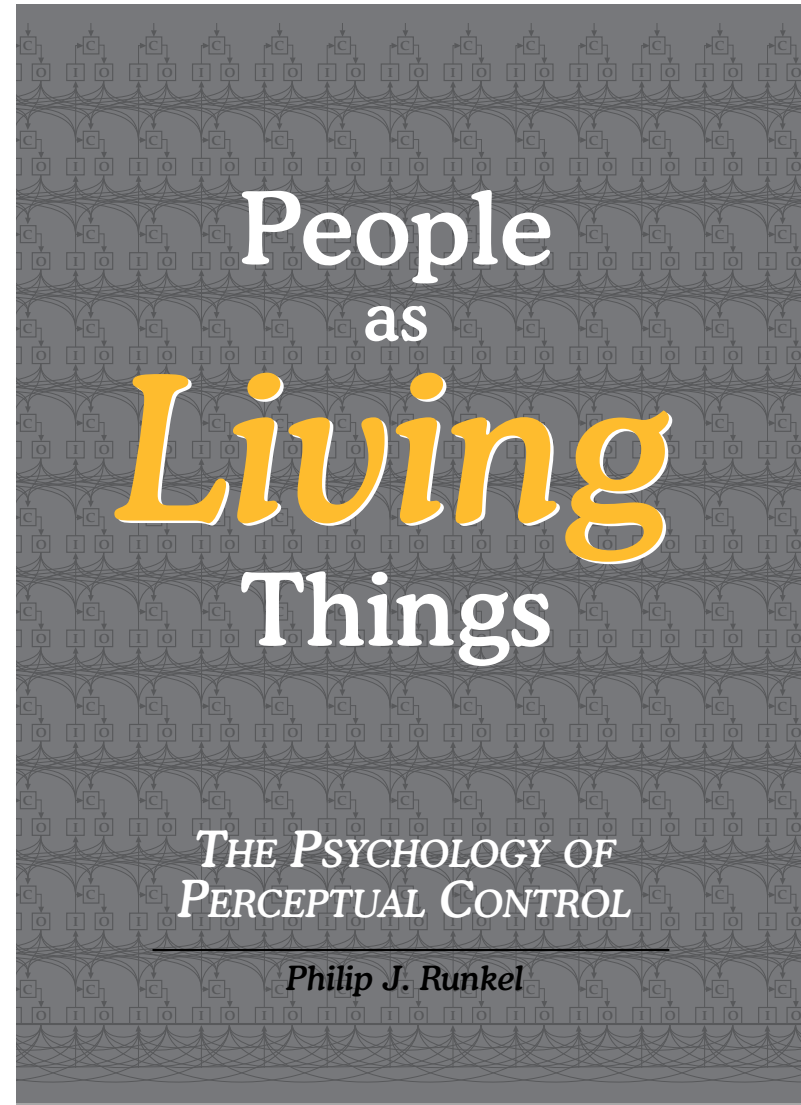
This is what is done in the physical sciences, where it is appropriate to study inanimate, non-living, objects this way. It is NOT appropriate for living things, where a want determines the action, if any, in response to the stimulus.

Phil Runkel, Professor of Psychology and Education at the University of Oregon, learned about PCT as he retired in 1985. He spent the next 18 years writing his seminal work, emphasizing in the title that PCT is the appropriate science of *Living* things. This work is a superb introduction to PCT, with plenty of comparisons to contemporary psychology, ideas and practices.

At a PCT conference in 2000, Runkel asked me to review his forthcoming manuscript for technical accuracy. I worked with him for three years, laid it out, and when done, Runkel asked me to publish it.

Afterwards, Runkel and Powers sent me their correspondence across 15 years.

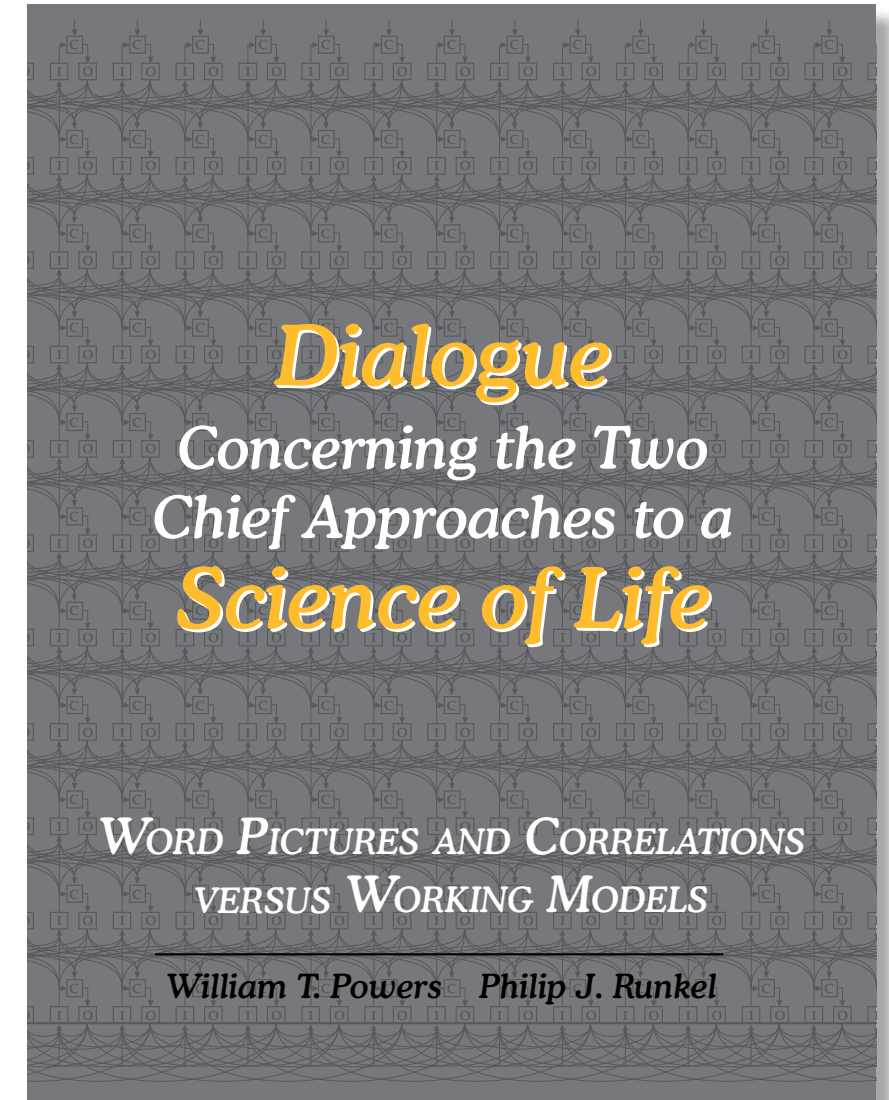
Henry Yin, Professor of Psychology & Neuroscience at Duke University, commented:



“Bill Powers is one of the clearest and most original thinkers in the history of psychology. For decades he has explored with persistence and ingenuity the profound implications of the simple idea that biological organisms are control systems.

His background in engineering allowed him to avoid many of the traps that have victimized even the best psychologists of the past. I believe his contributions will stand the test of time.”

Frans Plooi, head of Infant Studies in The Netherlands commented:



“Bill Powers’ work in the 20th century will prove to be as important for the life sciences as Charles Darwin’s work in the 19th century.

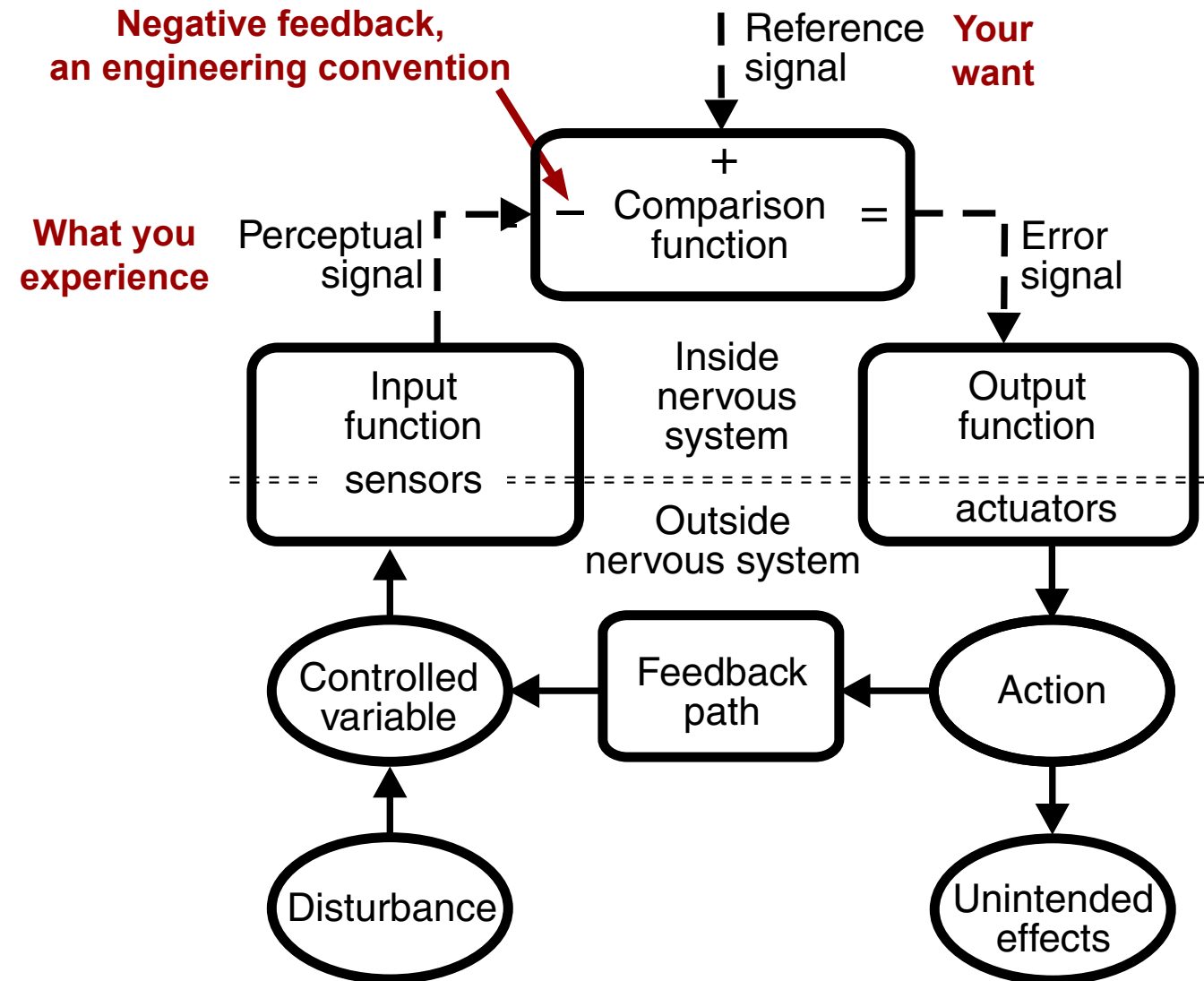
By the time this notion has become common knowledge, historians of science will be very happy with this correspondence between two giants.”

Time for a break.

1) Stand up and just lift one foot off the ground. This might depend on your physical ability but, if you can do it, you instantly notice a lot of twitching and adjusting happening down in your foot, ankle, and lower leg. This is a really graphic illustration of variable action (twitching, tensing, and so on) to achieve the experience you want (standing upright).

This is your system of control systems at work. All automatically—similar to the way you act when you drive.

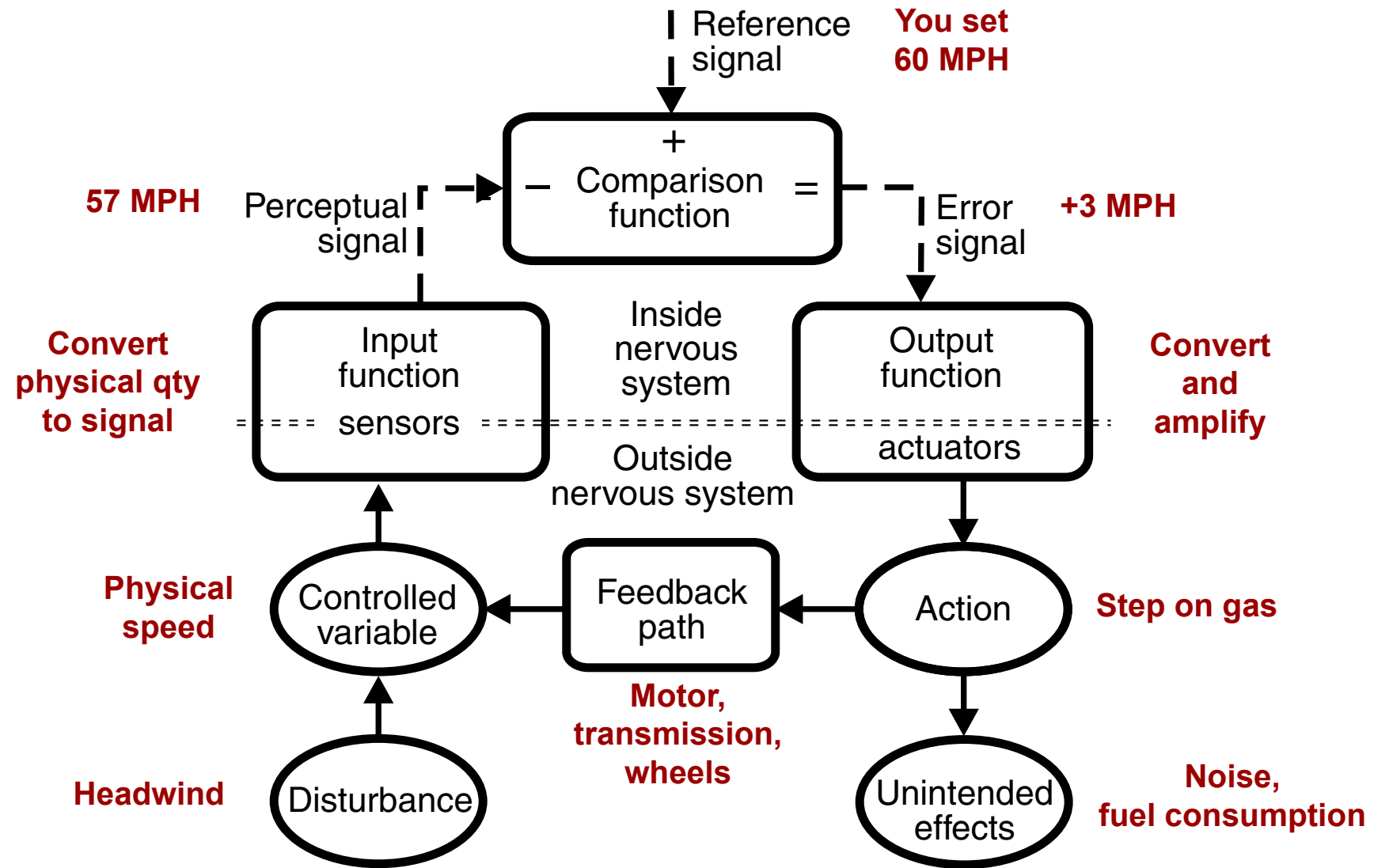
- 2) Walk around to stretch and get your circulation going. Pay attention to how you position your feet and take each step so that you keep your balance. You stand and walk as if you balance a broom in your hand—which is precisely how you stay upright all the time, except you yourself are the broom and your feet do the balancing.
- 3) Note that an understanding of purposeful control covers the whole range of how you live and function; how you can walk and talk, and chew gum, all at the same time.
- 4) You may want to ask me a question or two.
- 5) When we continue, I'll do my best to explain how control works.



Here is a functional diagram of a single perceptual control system. Control system on top, the environment outside the nervous system, which includes our bodies, below the dotted line.

Our nervous system operates like an analog, not digital, computer, with all functions and signals continuous and simultaneous.

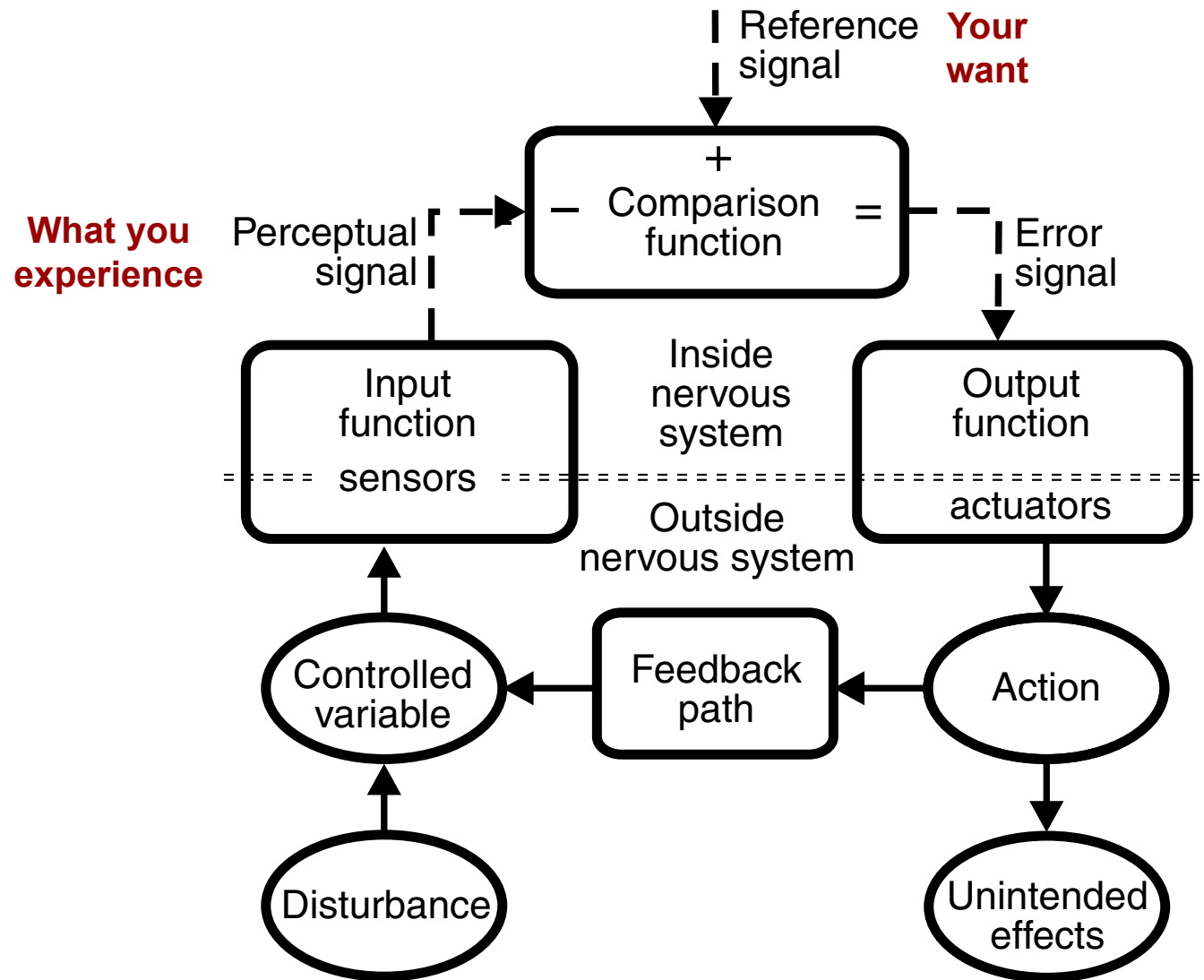
When you focus on a particular want, this simple functional diagram can serve as a summary of an entire hierarchical system of control systems working together.



It can also represent the cruise control in your car. You set the reference level for speed, say 60 mph. But a disturbance, such as a sudden headwind, slowed your car down, so right now, the sensor reads 57.

There is a difference of +3. The system takes that error signal and uses energy from fuel to amplify it into action.

When the sensor again reads 60, the error is zero. There is no difference between what the system wants and what it experiences. You might say that the system is satisfied, or content.



This is also how regulation and homeostasis works. Both words are synonymous with control!

Our bodies regulate things like blood sugar level and temperature.

It is generally understood that our bodies control these and other variables to constant or nearly constant Reference Values, such as 98.6 degrees.

Toward the end of WWII, Powers served as a navy electronics technician

[:livingcontrolsystems.com](http://livingcontrolsystems.com)

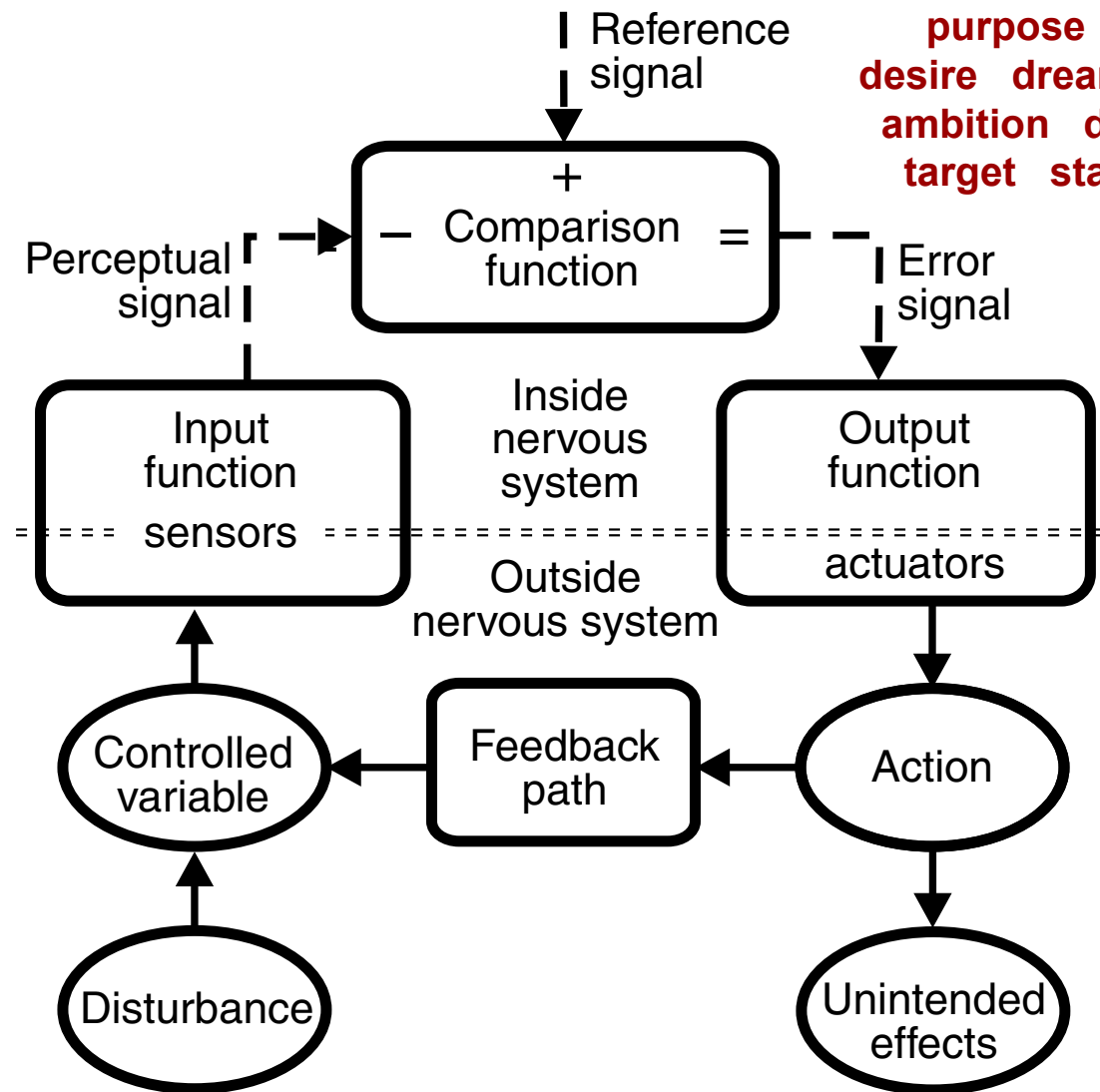
© Dag Forssell 2019

working with servos and analog computers. He knew that there is more to control than holding things steady. Indeed, with a rapidly varying reference signal, you might say a control system comes alive!

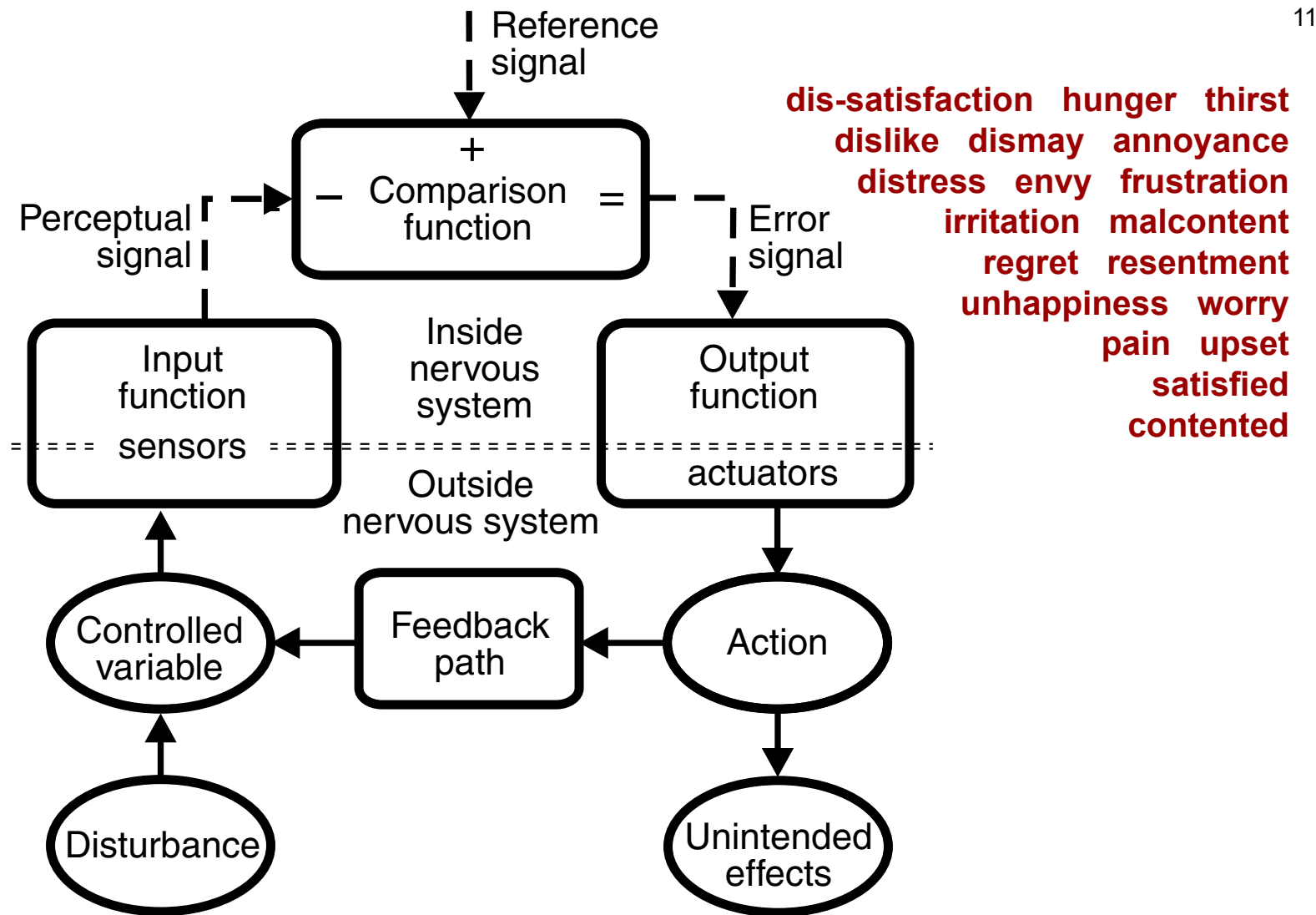
Since my jaw weighs little and my muscles are powerful, my jaw will track a rapidly varying reference signal for its position, coordinated with changing references for tongue position, vocal cord tension, and breathing.

That will produce phonemes which make up words and sentences and communicates thoughts. It is all control of perceptions!

purpose want aim objective
 desire dream goal hope intent
 ambition design plan purpose
 target standard opinion wish
 expectation

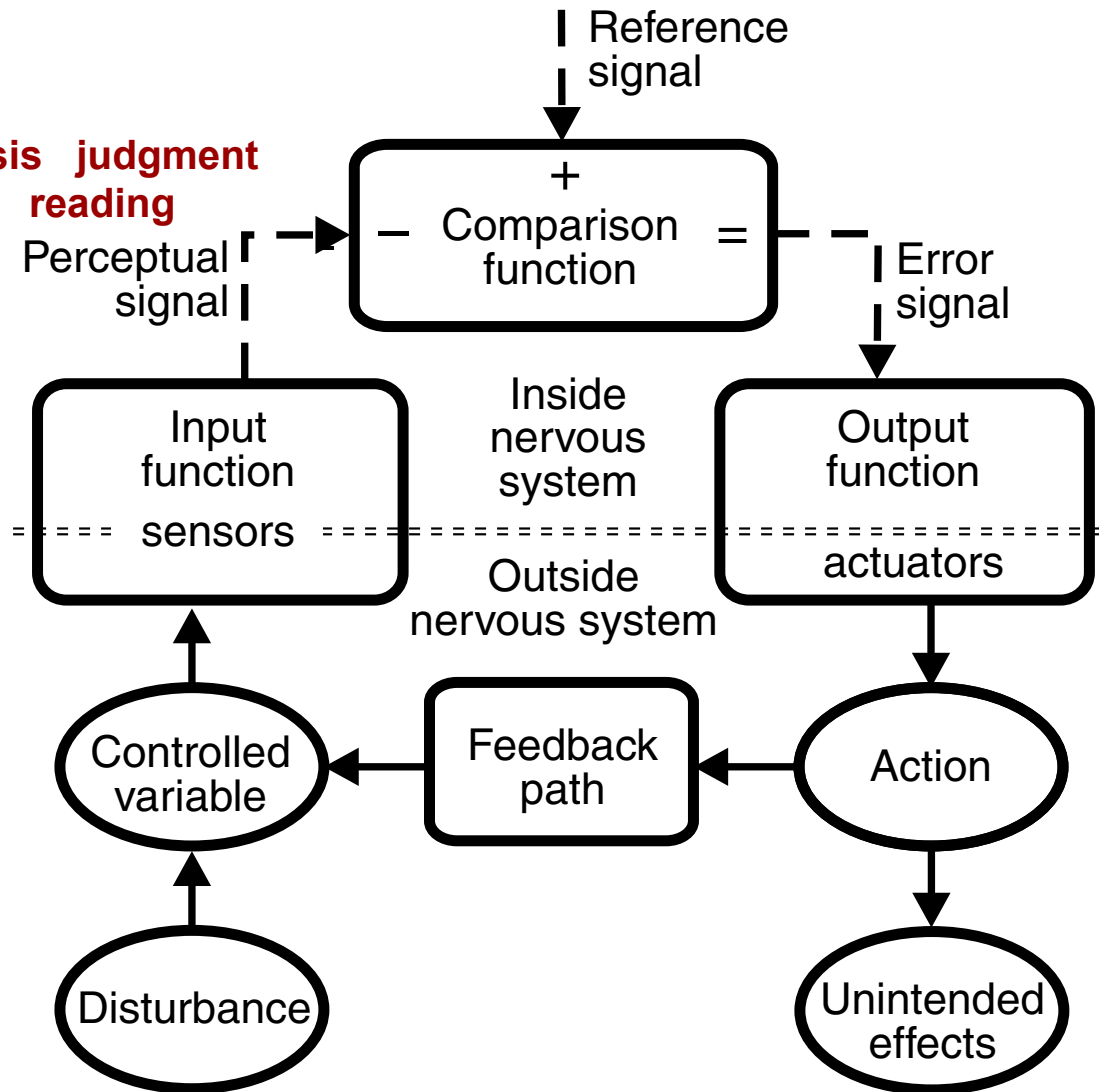


Once you realize that all we ever do is control our perceptions, it should come as no surprise that we have a rich vocabulary for talking about what the engineers call a Reference Signal.



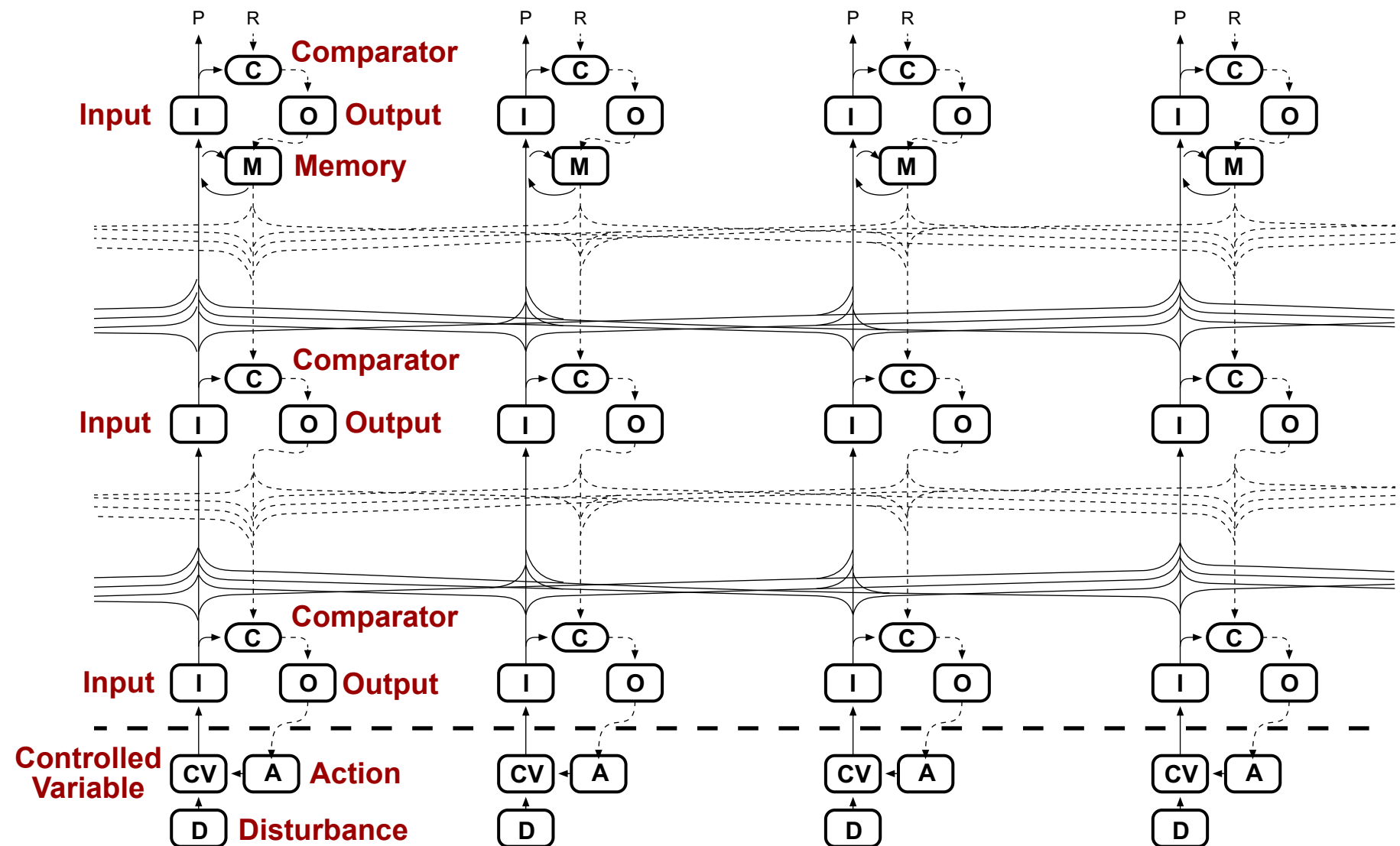
And an equally rich vocabulary for talking about what the engineers call an Error Signal.

interpretation analysis judgment
 meaning perception reading
 comprehension discernment
 insight description



And many ways of talking about our Perceptual Signals.

We are certainly more complex than a single control system like this.

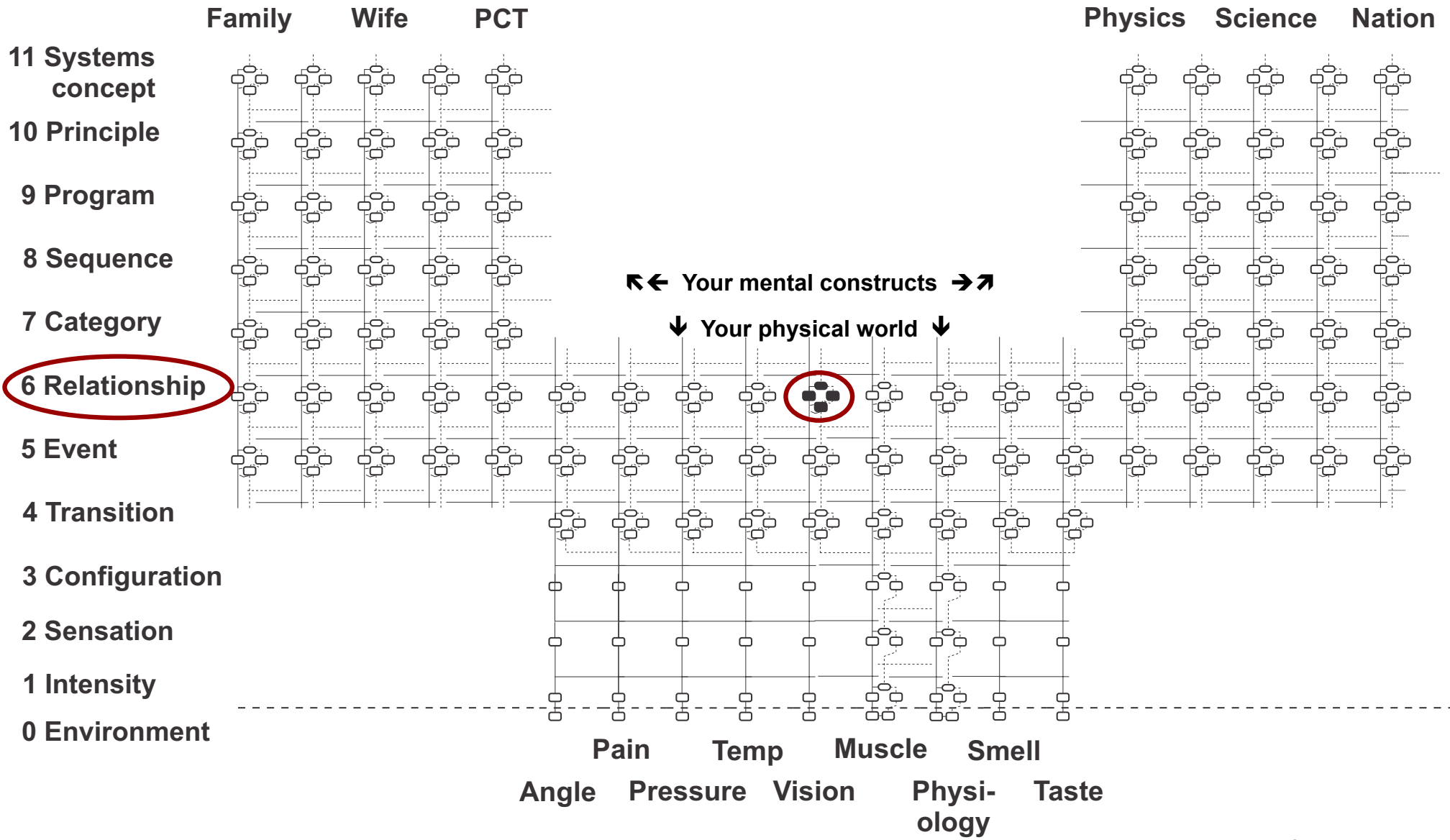


See: www.mindreadings.com/demos.htm Spreadsheet Simulation of Hierarchy of Control Systems

Here is a conceptual sketch of three levels of interconnected control systems, interacting with the world outside, shown below the dotted line.

A spreadsheet simulation of a hierarchy of control systems shows clearly that this interconnected hierarchy can satisfy many

different references controlling numerous variables. Kind of like you walking, talking and chewing gum at the same time.



And here is a conceptual sketch of the eleven levels of our perceptual hierarchy proposed by Powers.

This is Hierarchical PCT. This represents billions of control systems interconnected throughout your brain and nervous system.

Look at the Relationship level. We mean a spatial relationship, a position kind of thing. If that highlighted control system in the middle controls a perception of where I stand right now, and I change my want to be over there, an entire hierarchy of control systems will deliver.

How? At one level, I specify the new position. But I am not there.

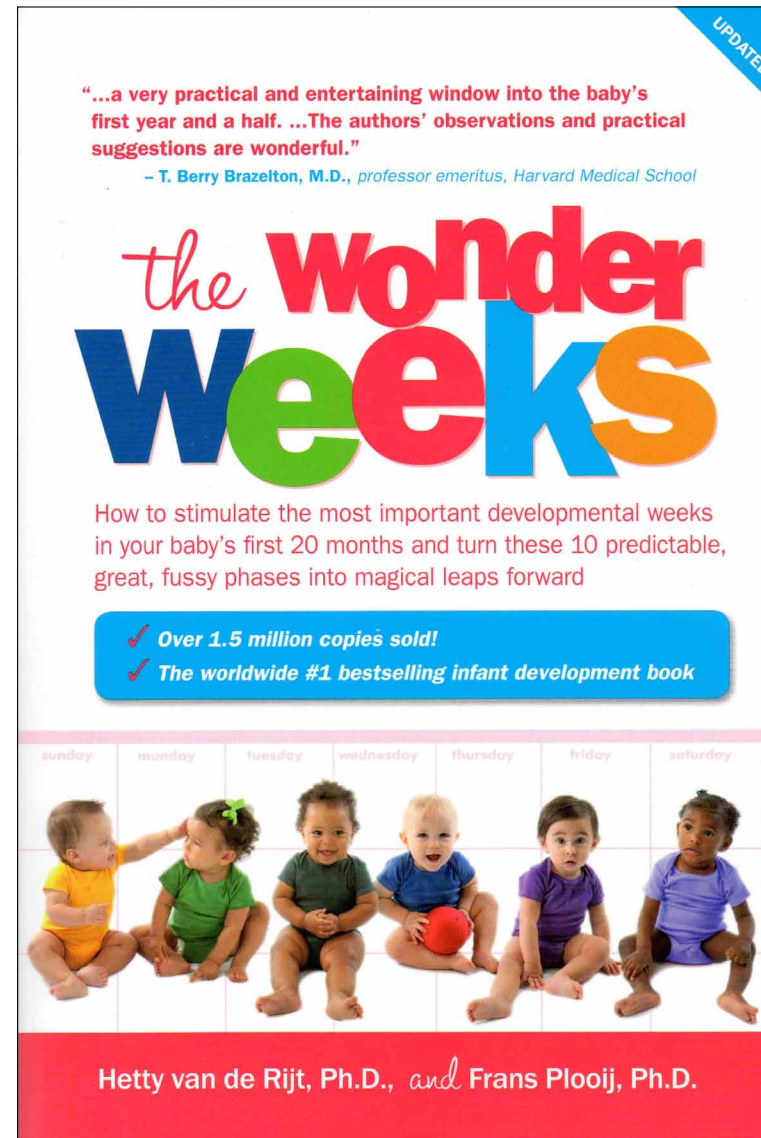
www.livingcontrolsystems.com

© Dag Forssell 2019

So a position error signal is transformed into reference signals for the next level down, specifying velocity.

But I am not moving, so a velocity error signal, in turn, is transformed into reference signals for yet another level down, specifying acceleration.

My muscles use energy from my metabolism to amplify that signal into force, which becomes acceleration, and velocity, and deliver me to my new position.



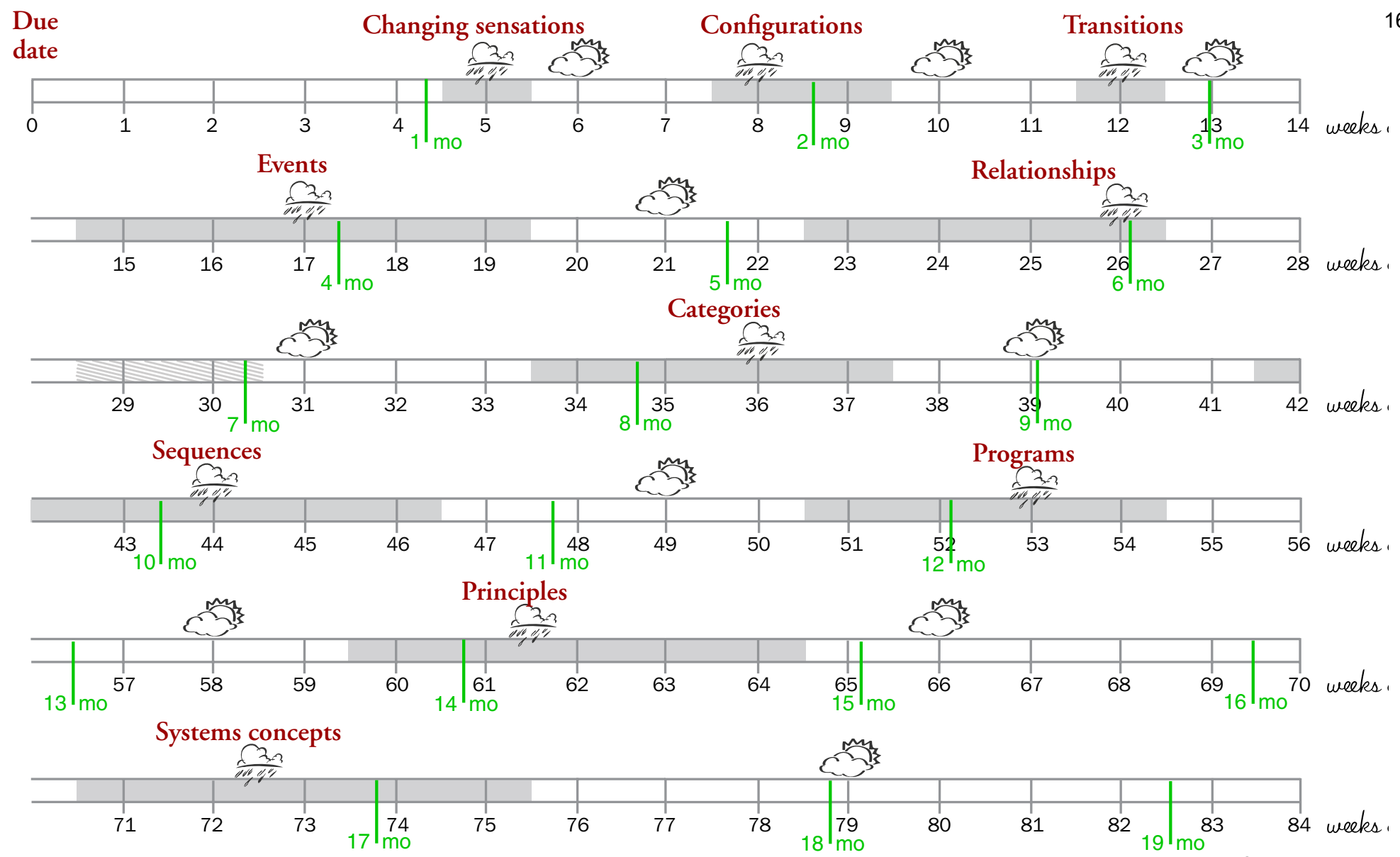
www.livingcontrolsystems.com

About this Book	xi
Introduction	1
Leap Alarm	8
Chapter 1: Growing Up: How Your Baby Does It	9
Chapter 2: Newborn: Welcome to the World	19
Chapter 3: Wonder Week 5: The World of Changing Sensations	37
Chapter 4: Wonder Week 8: The World of Patterns	55
Chapter 5: Wonder Week 12: The World of Smooth Transitions	83
Chapter 6: Wonder Week 19: The World of Events	109
Chapter 7: Wonder Week 26: The World of Relationships	147
Chapter 8: Wonder Week 37: The World of Categories	197
Chapter 9: Wonder Week 46: The World of Sequences	231
Chapter 10: Wonder Week 55: The World of Programs.	269
Chapter 11: Wonder Week 64: The World of Principles.	305
Chapter 12: Wonder Week 75: The World of Systems	371
Postscript: Countless Wonders	443
Further Reading	447
Index	450
Internet	465

© Dag Forssell 2019

Let us look at some tangible evidence.

The Wonder Weeks is a parenting book that spells out when your layers of perception and control developed and what mental capabilities emerged in you with each layer.

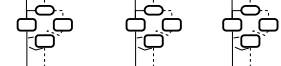
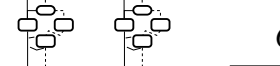

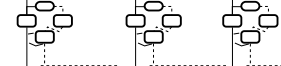
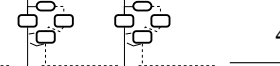
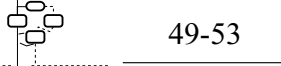
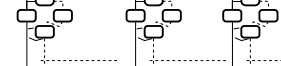
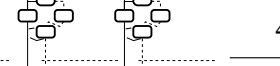
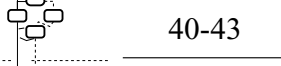
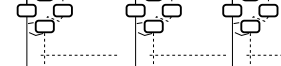
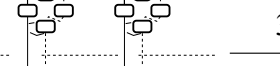
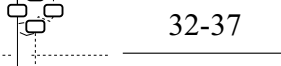
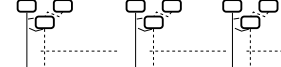
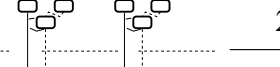
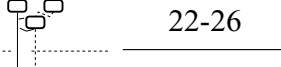
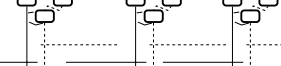
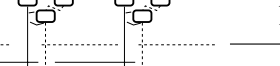
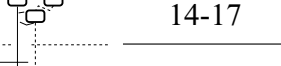
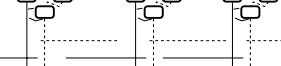
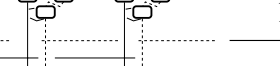
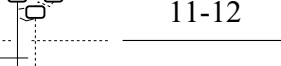
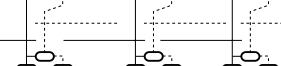
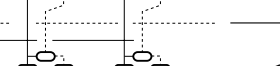
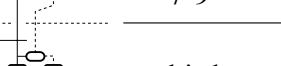
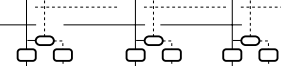
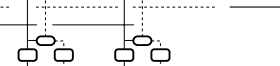






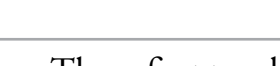


Here is the timeline from this book. Notice the storm-cloud shaded periods and the sunny clear periods.

On mother nature's schedule, during each cloudy period, your cranium expanded, your brain grew, and you were bewildered.

Perhaps you cried, would not sleep, would not nurse, just clung to mother.

Once you settled in with your new perceptual capability, your life turned sunny again.

Levels of perception and control	Proposed structure of hierarchical control	Emergence in infants, weeks	Comments, examples - Adult perspective -		
11 Systems concept	?	?	?	70-75	Understanding, belief, the way things are, sense of self, identity.
10 Principle				60-64	Generalizations, criteria, standards, priorities, values.
9 Program				49-53	Choices, logical procedures.
8 Sequence				40-43	Simple or repetitive series of events and elements.
7 Category				32-37	"Class membership." Chair, woman. Symbols--words.
6 Relationship				22-26	Walk "on" floor. Bark, dog. Knot "above" target.
5 Event				14-17	Open door, hug, fall, cranking, bounce, reach, grasp, walk.
4 Transition				11-12	Changes in general. Movements.
3 Configuration				7-9	Patterns, edges, texture, posture.
2 Sensation				birth	What kind and how much: Loud, bright, hot, sour, dry,
1 Intensity					Frequency of neural current originated in nerve ending.
0 Environment					Physical effect on nerve ending. Nerve signal to muscle or organ.

www.livingcontrolsystems.com

© Dag Forssell 2019

Here is the same timeline with more detail.

Everything that you experience in the world—such as myself in front of you right now—starts with neural sensors on your retina, in your ears, skin, and all over.

Each sensor, when it gets tickled by something physical—such as pressure, light, vibration, chemicals—creates a neural current of impulses [brrrrr], up to 1,000 a second, that propagates from neuron to neuron at somewhere between 100 and 600 mph.

That's a simple Intensity signal, which you see represented here at the bottom of the hierarchy.

At the next level, Intensity signals are combined into neural signals that we experience as Sensations, such as the pressure of the floor against your feet, the temperature of the air, a brown color.

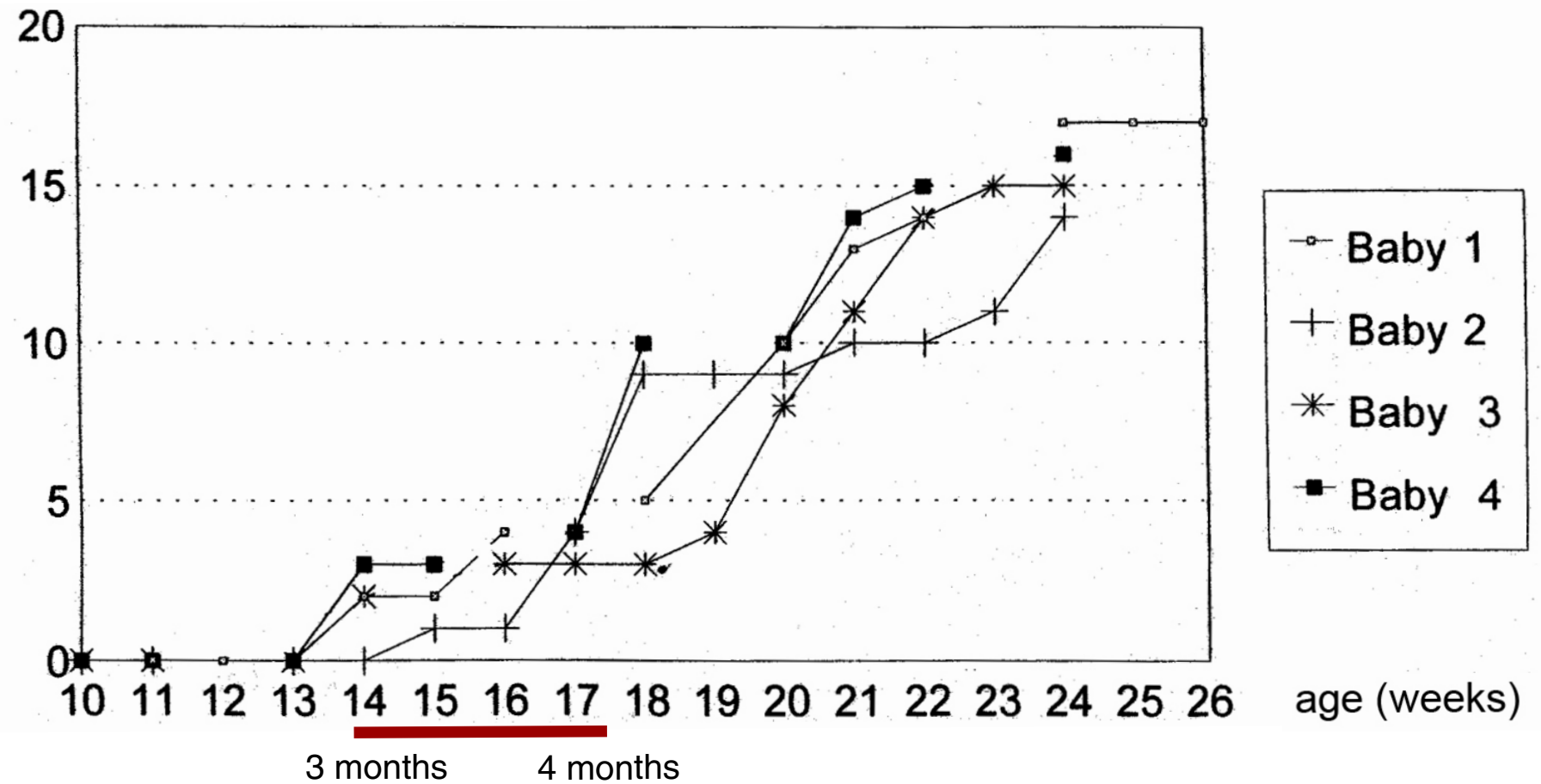
Those first two levels, Intensity and Sensation, were in place when you were born.

At 7 to 9 weeks after your due date, your ability to combine Sensations into Configurations developed. Think lemonade, a combination of sweet, sour, and flavors.

By 11 to 12 weeks you developed the ability to discern Transitions between configurations.

And by 14 to 17 weeks, or 4 months, Events—short, familiar sequences of Transitions.

Cumulative number of events



From: <http://www.livingcontrolsystems.com/WW/TheWonderWeeksStory.pdf>

In this slide, Frans Plooij gives a sample of the research behind the book.

A variety of Event actions were presented to infants to see at what age they would respond. livingcontrolsystems.com

Frans told us at a conference that the Lego people asked him for advice about a simple toy—a handle, spring and bob—something like this.

A baby could hold the handle and wiggle it so the spring and bob would swing back and forth, back and forth, back and forth... Frans said “Aha, this is an Event. Label the package for four months” ... back and forth...

You are probably bored already, but babies would not tire because they could not perceive anything more complex at that age. The toy sold like hotcakes.

You can perform this test yourself on an infant you know, starting at week 12 and repeating until your infant responds.

Why



How



Levels of perception and control	Proposed structure of hierarchical control	Emergence in infants, weeks	Comments, examples - Adult perspective -
11 Systems concept	? ? ?	70-75	Understanding, belief, the way things are, sense of self, identity.
10 Principle		60-64	Generalizations, criteria, standards, priorities, values.
9 Program		49-53	Choices, logical procedures.
8 Sequence		40-43	Simple or repetitive series of events and elements.
7 Category		32-37	"Class membership." Chair, woman. Symbols--words.
6 Relationship		22-26	Walk "on" floor. Bark, dog. Knot "above" target.
5 Event		14-17	Open door, hug, fall, cranking, bounce, reach, grasp, walk.
4 Transition		11-12	Changes in general. Movements.
3 Configuration		7-9	Patterns, edges, texture, posture.
2 Sensation		birth	What kind and how much: Loud, bright, hot, sour, dry,
1 Intensity			Frequency of neural current originated in nerve ending.
0 Environment			Physical effect on nerve ending. Nerve signal to muscle or organ.

I hope you begin to see how each new layer of perception and control builds on the previous.

By 20 months your entire hierarchy was in place and you had likely developed an understanding of Family, a Systems Concept.

There is no need to memorize what the proposed levels of perception are called. It is quite enough to realize that a want somewhere in the middle is derived from higher levels of perception and control, which I like

to call understanding for short. You can always ask WHY to go up a level in the hierarchy.

If you want to influence behavior, you have to influence the want that

the behavior attempts to satisfy—and to influence the want, you have to influence higher levels of understanding..

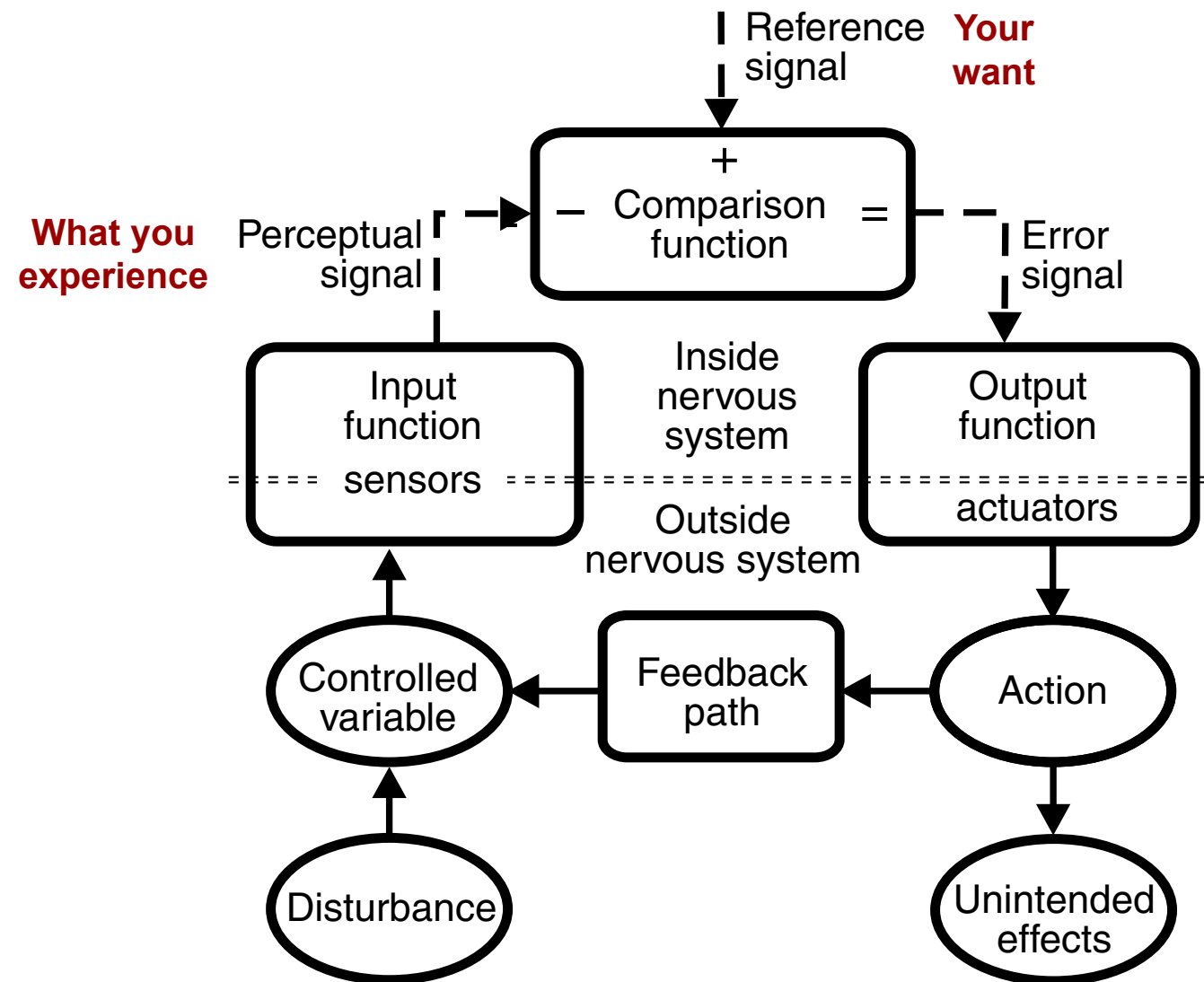
As time went on, you had experiences, drew conclusions, learned language and culture from people around you, and developed your very own, personal, unique, mental world of understandings.

The terrible twos and fearsome fours can be seen as manifestations of how children discover that they control and insist on doing it by themselves.

By the time you were a teen, your wise parents became trusted advisers who gave you good information, but allowed you to control by yourself. If they insisted on micro-managing you, the conflict probably escalated to rebellion. We all insist on controlling by ourselves.

Now that you are an adult, details of your early experiences and the conclusions you drew have probably faded. But memories are still there in the form of strong, very personal understandings about how things should be.

You act to make your experiences match those understandings and you push back against disturbances to your understandings, just like the cruise control resists disturbances to the speed you set.



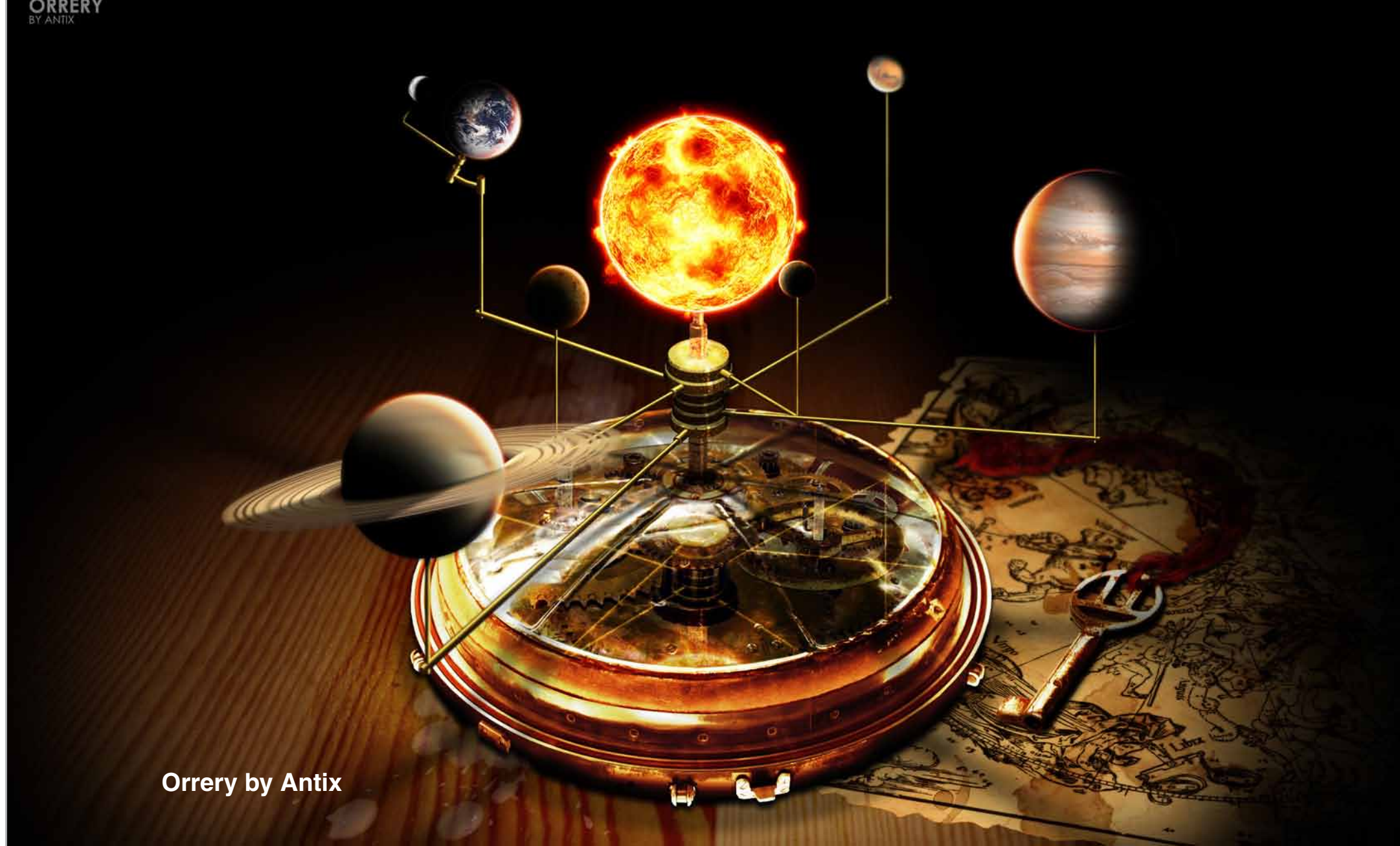
Why do I say that this is a revolution in the sciences of life?

Perceptual Control Theory (PCT) is not just one more descriptive theory. It is different in kind.

PCT is a functional, precisely quantified, generative theory. The kind you find in physics, chemistry, and the other “hard” sciences, where demos and lab experiments replicate perfectly every time—no statistics necessary.

PCT demos work every time.

A generative theory allows you to build functioning models, whether mechanical or as simulations in a computer, models that function by themselves, without intervention.



Orrery by Antix

Think of astronomy again, today a “hard” science. This mechanical simulation of the solar system helps us grasp what’s behind the movements of planets in the sky.

You can see why—from earth it looks as if the other planets move backwards from time to time, and with more detail you can predict

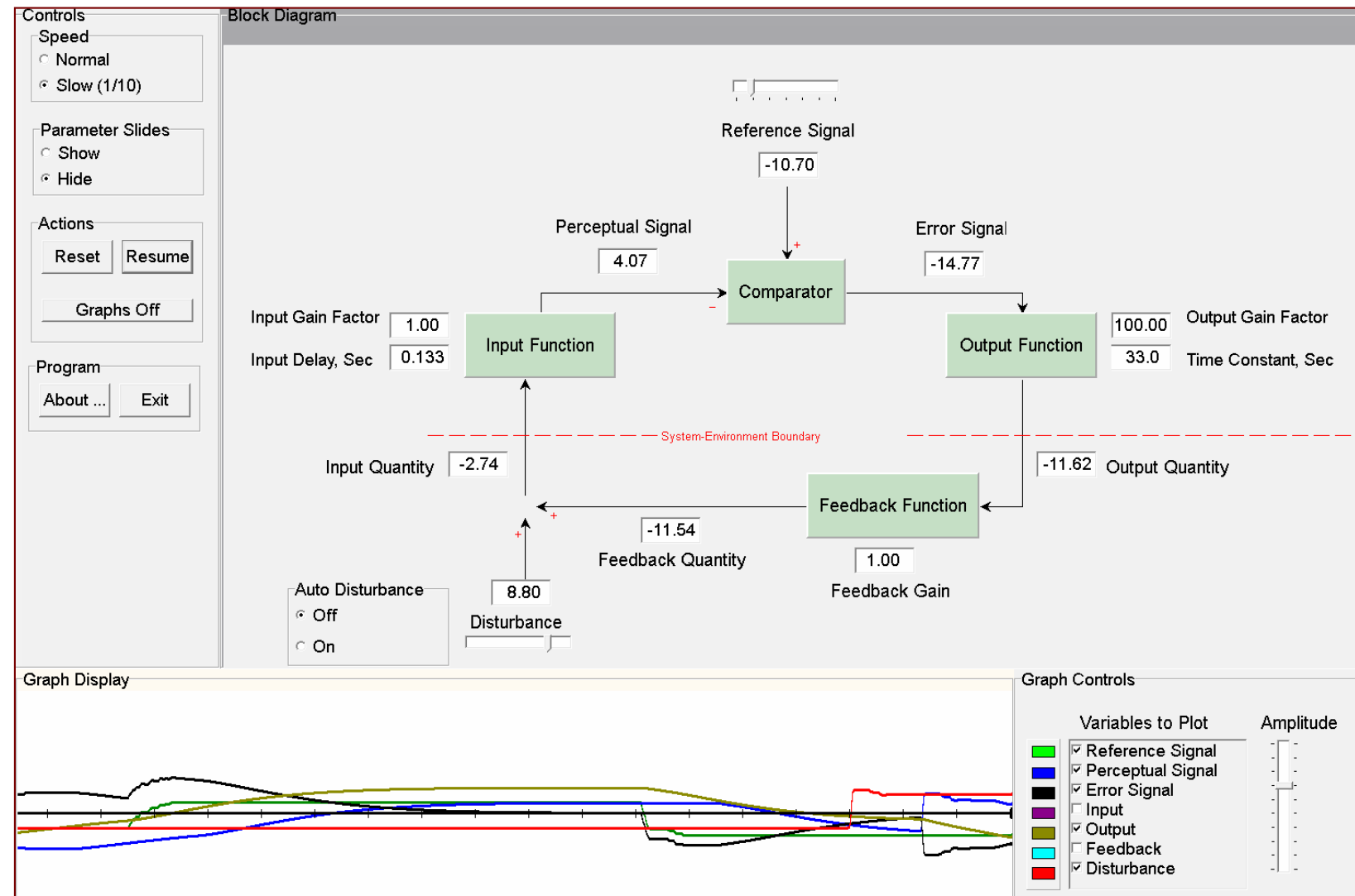
that if you launch the spacecraft Voyager 2 just so, it will swing around Jupiter, Saturn, Uranus and go on past Neptune.

That was impossible with Ptolemy's descriptive astronomy. You can appreciate that there is a difference like night and day in explanatory power between a theory based on appearances, descriptions, subjective interpretation and statistics, compared to a functional, quantifiable theory that allows you to generate predictable results.

That's the difference between soft and hard science.

Generative theories have powered progress in the physical sciences and engineering in recent centuries, and, once Perceptual Control Theory is widely understood, this generative theory will power progress in the sciences of life for decades and centuries to come.

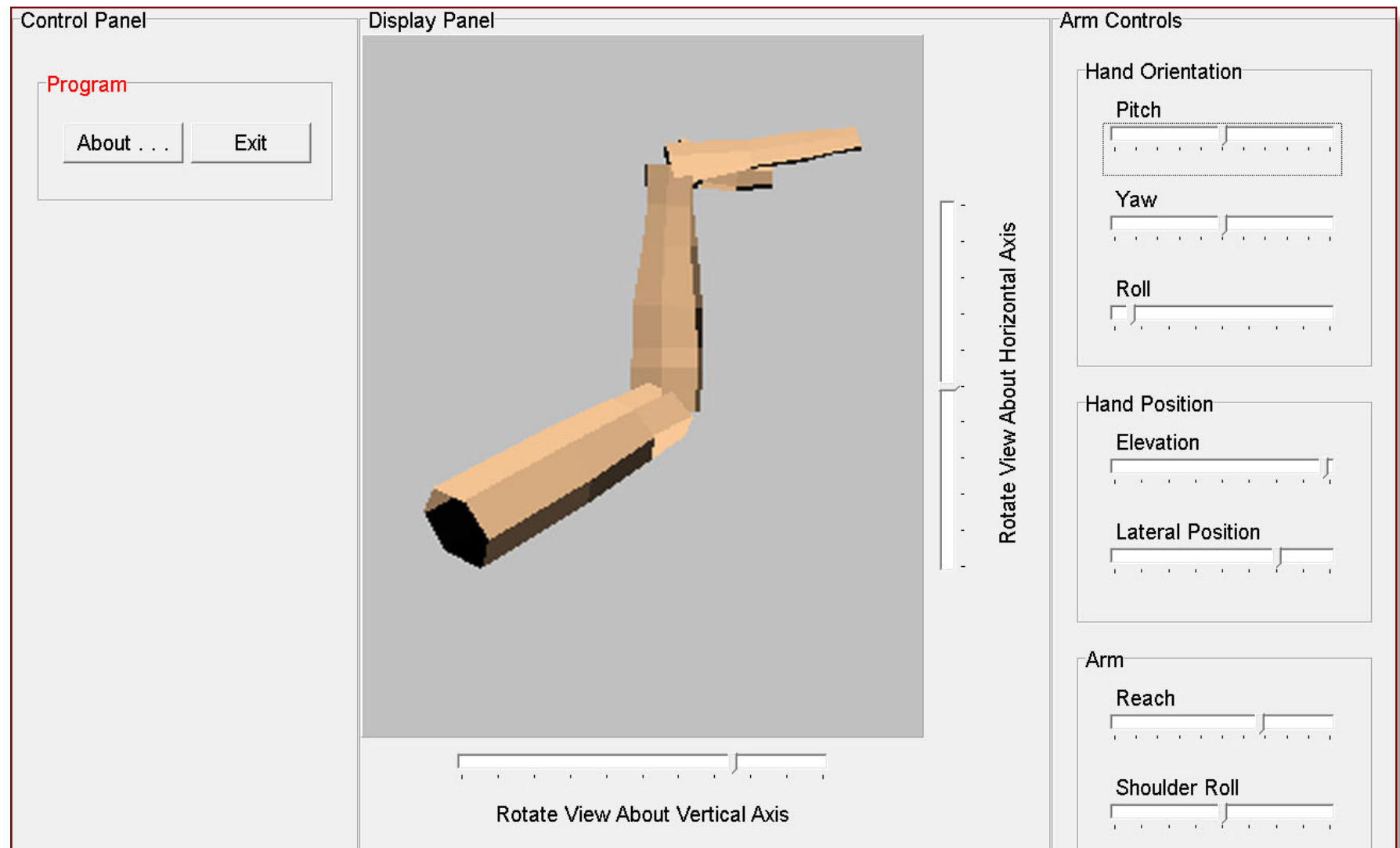
Just like this orrery, PCT tutorials and simulation programs help us grasp what's behind outward appearances as we go about living.



Demo 3-1, one of 13 tutorial / demonstration programs in *Living Control Systems III — The Fact of Control*

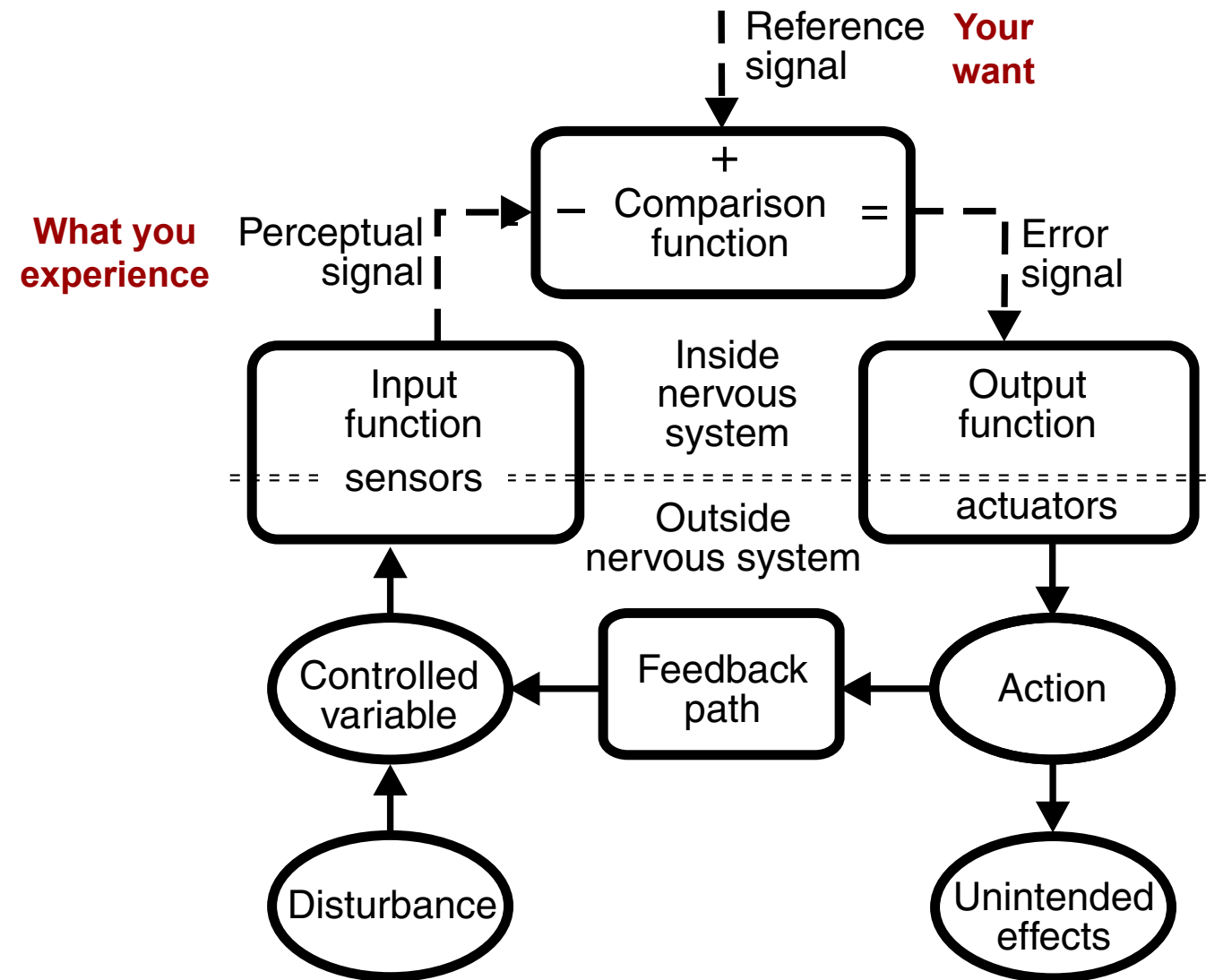
This is a screen shot from one of Powers' many tutorial programs. You can set parameters and make rapid changes to the Reference Signal and Disturbance.

The effects of your changes show up immediately in the graph display.



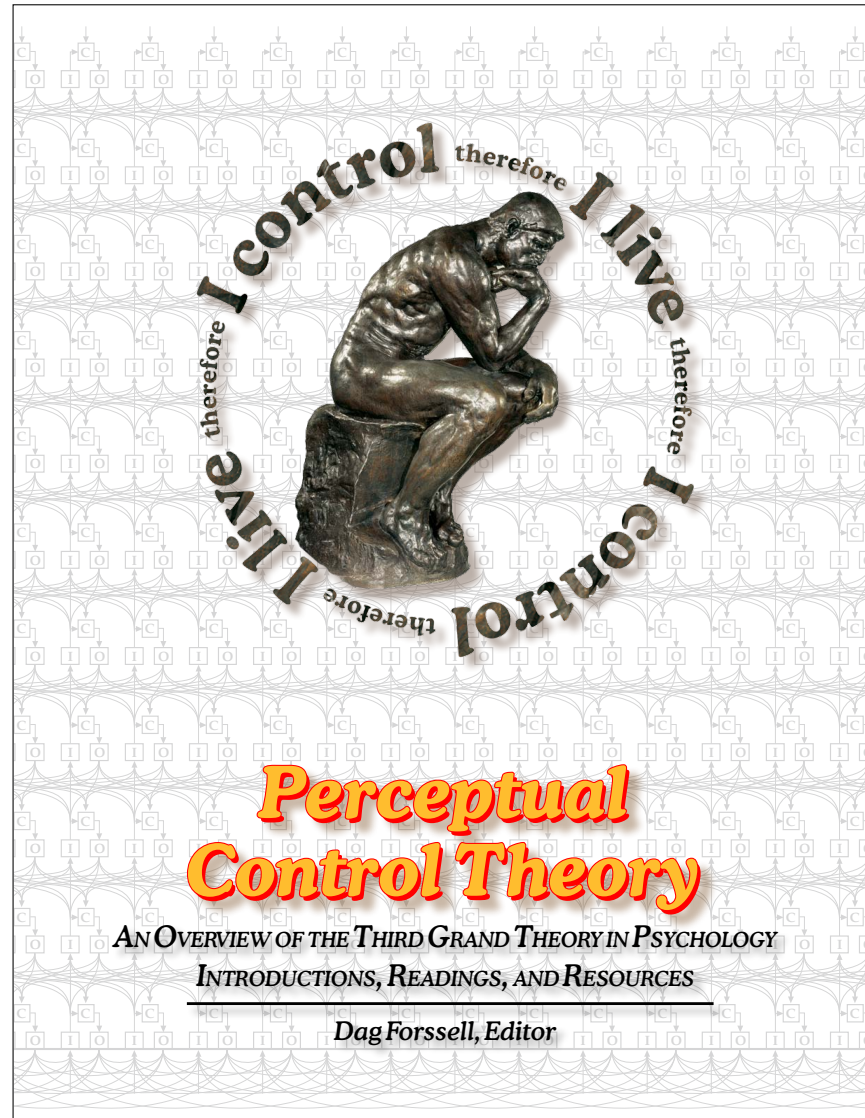
Demo 8-2, one of 13 tutorial / demonstration programs in *Living Control Systems III — The Fact of Control*

And with this program you can change reference signals for the arm so it twists and turns just like yours.



Sharing this simple elegance of PCT with you is not easy.

It is necessary for you to study and understand the facts of control before you can see that PCT does explain how we all function, and that today's multitude of descriptive theories do not.



www.livingcontrolsystems.com

© Dag Forssell 2019

**Book of Readings
and Resources**
Free pdf download @
livingcontrolsystems.com

34 short papers

**24 books, most with
complete chapters**

Links to resources

To study PCT, I recommend that you download the free *Book of Readings and Resources* pdf, or purchase a printed copy, and start by reading some of the 34 papers.

The 2016 edition also holds the tables of contents of 24 books, in most cases followed by a reprinted chapter, and it links to lots of resources on the web. The next edition will appear in mid-2020.

Papers

- TEN MINUTES
- THE DOMAIN OF PCT
- DESCRIPTIVE VS. GENERATIVE SCIENTIFIC THEORY
- EVALUATING PCT
- THE FUTURE OF PCT
- WHY STUDY PERCEPTUAL CONTROL THEORY?
- PCT IN 11 STEPS
- REORGANIZATION AND MOL
- A MODEL FOR UNDERSTANDING ... CONTROL
- AN ESSAY ON THE OBVIOUS
- THINGS I'D LIKE TO SAY IF THEY WOULDN'T TALK
- PCT IS REVERSE ENGINEERING
- THE TANK THAT FILLED ITSELF
- MARY ON PCT
- ABOUT DISORDERLY BEHAVIOR: A HIGH-WIRE ACT
- IS PCT A THEORY OF CONTROL?
- CONTROL THEORY: A FOUNDATION FOR PSYCHOLOGY
- BYTE ARTICLES—THE NATURE OF ROBOTS
- RUNNING PCT
- EXPERIENCE
- THE UNDERPINNINGS OF PCT
- TEACHING DOGMA IN PSYCHOLOGY

Reviews

Papers on-line

Books

- BEHAVIOR: THE CONTROL OF PERCEPTION** 125
Bill Powers' original, seminal work on PCT. Includes technical information.
- MAKING SENSE OF BEHAVIOR: THE MEANING OF CONTROL** 146
Bill Powers' book on PCT written in more accessible language, without diagrams.
- LIVING CONTROL SYSTEMS: SELECTED PAPERS OF WILLIAM T. POWERS** 157
Bill Powers' first volume of papers on numerous topics.
- LIVING CONTROL SYSTEMS II: SELECTED PAPERS OF WILLIAM T. POWERS** 183
Bill Powers' second volume of papers on numerous topics.
- LIVING CONTROL SYSTEMS III: THE FACT OF CONTROL** 204
Bill Powers' book with computer simulations and demonstrations of control.
- DIALOGUE CONCERNING THE TWO CHIEF APPROACHES TO A SCIENCE OF LIFE** 226
Lucid correspondence between Phil Runkel and Bill Powers.
- PEOPLE AS LIVING THINGS: THE PSYCHOLOGY OF PERCEPTUAL CONTROL** 240
Phil Runkel's seminal work relating PCT to human behavior.
- CASTING NETS AND TESTING SPECIMENS** 250
Phil Runkel's discussion of statistics and experimental design.
- CONTROLLING PEOPLE: THE PARADOX OF CONTROL** 255
Rick Marken and Tim Carey provide an introduction to and overview of PCT for everyone.
- THE WONDER WEEKS: ... HELP HIM TURN HIS 10 MONTHS INTO MARCH LEAPS FORWARD** 260
Frans and Hetty Plooij on the development of perception in infants.
- THE METHOD OF LEVELS: HOW TO DO IT** 270
Tim Carey's seminal work on the Method of Levels.
- PRINCIPLES-BASED COUNSELLING AND PSYCHOTHERAPY: A METHOD OF LEVELS APPROACH** 290
Tim Carey et al introduce PCT, explain the Method of Levels, and apply it to PCT MOL.
- A TRANSDIAGNOSTIC APPROACH TO CONTROL** 313
Warren Mansell, Tim Carey, and Sarah Mansell.
- CONTROL IN THE CLASSROOM: AN ADVENTURE IN LEARNING AND ACHIEVEMENT** 314

Resources at websites

Focus on MOL

Focus on management

You will find information about cooperation as well as conflict—conflict between people and within a person, emotions, language, neurology, biology, and more.

For people in organizations, I recommend the two papers on effective personnel management, the book on Management, and the book on the Method of Levels, which is a spectacularly effective

approach to psychotherapy, based on an understanding of your perceptual hierarchy. It provides hints about how to interview your associates so you can understand what motivates them.

If you are working on autonomous robots and artificial intelligence, you will find reports on how PCT can make a difference in these fields.

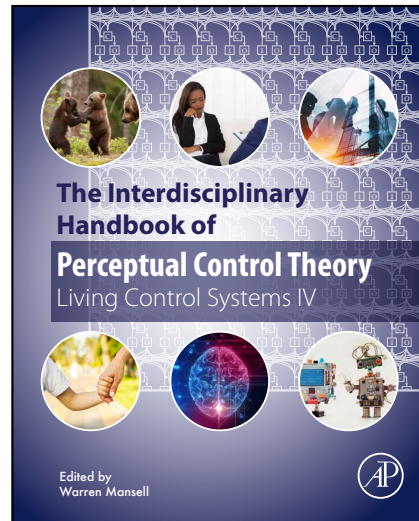
Continue slide

Understanding the basics of PCT will only be your beginning. As you experience interactions in your daily life, you will examine them in the light of your understanding of PCT.

Over time, your understanding will mature and flavor your entire outlook on life.

Well, that is how I see the revolution that is emerging in the sciences of life.

Handout
to follow Dag's presentation



Coming from Elsevier in mid-2020:

*The Interdisciplinary Handbook of
Perceptual Control Theory
Living Control Systems IV*

(Cover and text below are preliminary,
subject to change prior to publication.)

www.livingcontrolsystems.com

Please help yourself to my handout. It features the forthcoming interdisciplinary handbook on PCT, a delightful essay on our controlling nature, and compelling demonstrations.

Psychology Today

You Have to Control...

...It's one of nature's non-negotiables. Control is not so much what we do as what we are. We can never step outside the process of organic, autonomous control. Well, not until we take that final step into whatever lies beyond our earthly existence.

Control is even more fundamental than breathing in and out. Whereas you can suspend breathing for brief periods of time, you cannot suspend control. Not even for a moment.



We can't let there be a difference between what we want and what we're getting exist for very long without acting. The way we go about reducing that difference might not be predictable, or even observable to others. But we will reduce this

Focus on demonstrations

Perceptual Control Theory can be demonstrated in compelling ways, such as movement of your arms, legs and eyes; computer tutorials and simulations, robots and bugs operating in computer programs, and functioning robots all implementing the PCT hierarchy—layers of interacting control systems.

TUTORIALS AND SIMULATIONS

*Self-Demonstration of a
Human Control Hierarchy*

To demonstrate several “nested” control systems in the body, begin at **First Order**, which is exemplified in the spinal reflex loop. A subject (S) extends his or her arm in front of him or herself, with instructions to hold it steady, and the experimenter (E) places his or her hand lightly on top

Third-Order Control. Third-order variables are named “static configurations.” They combine classes of sensation feedback. E instructs S as in the second-order demonstration, but now requesting that the movement be made sideways, again making the initial press in the direction of motion.

© Dag Forssell 2019

To learn more...

www.iapct.org

www.pctweb.org

www.livingcontrolsystems.com

www.mindreadings.com

www.methodoflevels.com.au/

www.psychologytoday.com/us/blog/in-control

www.pct-labs.com

www.perceptualrobots.com

I do hope that you have caught a glimpse of the beauty, explanatory power, and insight that awaits you when you choose to study PCT with care.

Thank you!

I trust you have questions.