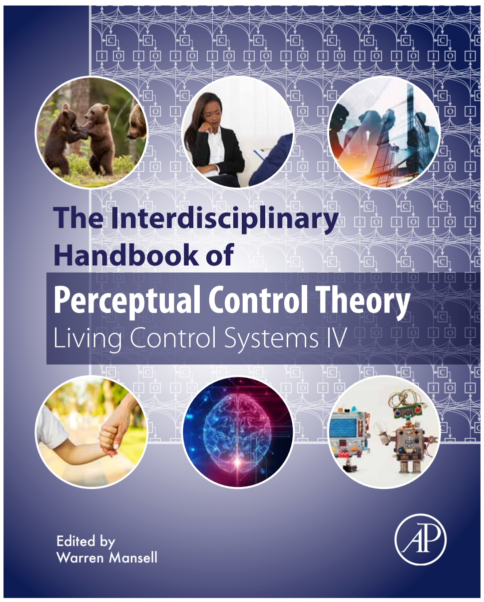
Handout

Review Dag's presentation at
www.livingcontrolsystems.com/intro



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

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 priorto publication.)

The Interdisciplinary Handbook of Perceptual Control Theory brings together the latest research, theory, and applications based on W. T. Powers' Perceptual Control Theory (PCT). PCT proposes that the behavior of a living organism is the control of perceived aspects of itself and its environment. The book begins by introducing the theory, with subsequent chapters describing the application of PCT to a broad range of disciplines, each chapter written by an internationally recognized expert in their field.

The Interdisciplinary Handbook of Perceptual Control Theory shows psychologists why perceptual control is fundamental to understanding human nature; it shows neuroscientists a new way to do research on brain processes and behavior; it shows evolutionary biologists how the role of natural selection in behavior can be demystified; it shows sociologists a new way of thinking about conformity and diversity within social groups; it shows linguists how people use language to construct shared information grounded in personally embodied meanings; it shows computer scientists how to model psychological processes using artificial intelligence with a fraction of the computational cost of other approaches; and it shows engineers how to emulate human purposeful behavior in robots. Each chapter includes an author biography to set the context of their work within the development of PCT.

Key features

- Includes a previously unpublished essay by William T. Powers—developer of PCT
- Presents case studies to show how PCT can be applied in different disciplines
- Illustrates the Test for the Controlled Variable (TCV) and the construction of functional models as fruitful alternatives to mainstream experimental design when studying behavior
- Shows how the theory illuminates structure and functions in brain anatomy
- Compares and contrasts PCT with other contemporary, interdisciplinary theories
- Demonstrates how PCT provides a novel, critical approach to the assumptions and methodology of many scientific disciplines, thereby transforming the student learning experience

Edited by Warren Mansell, Reader in Clinical Psychology, University of Manchester, UK

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 by holding your breath, you can't stop controlling. Not ever. Breathing, actually, is part of a control process.

We are, essentially, a conglomeration of control processes. Or maybe a "choir" or an "orchestra" would be better metaphors to emphasize the coordinated and interconnected nature of all our control systems.

People have developed different ways of thinking about and categorizing control. For example, some people seem to find it useful to discuss things like "perceived control," or "locus of control," or "objective control," or "illusory control," and other aspects of control at different levels. Ultimately, it's all just control.

It's difficult, in fact, to know just exactly what some of these terms mean. All control, for example, involves perception, but you don't have to perceive "control" in order to control. You certainly have to perceive the thing that you are controlling, but "perceived control" would seem to imply that what is being controlled is control, which is a bit hard to make sense of!

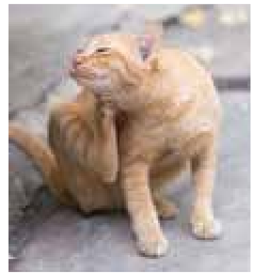
All of our activity—all of our thinking, imagining, debating, dreaming, planning, inspecting, scrutinizing, sharing, hallucinating, concentrating, meditating, and so on—is all control.

Even not controlling is control. There is no denying that some people like to create states where they feel detached, perhaps "going with the flow," or being "in the zone." Paradoxically, the fact that they can create and maintain these states is strong evidence that they are controllers. Similarly, "letting go of control" is a control process!

We don't even use control in the sense that someone might use a broom to sweep the leaves off the front porch. There is no "I" or "me" that is separate to, or somehow outside of, the control process that uses their body or their mind to live the life they want.

Understanding control and how it works can be illuminating. As controllers, we all have specifications for the way in which we want different aspects of the world, including ourselves and our position in it, to be. That's a fact. These specifications are ours and ours alone. No one can give us or otherwise persuade us or force us to take on a particular specification or a value for it if we don't want it. That's another fact.

When there is a difference between the way we are experiencing the world and the way we have specified we want it to be, we must do something. That's another fact. Itches must be scratched!



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 the fact that we will reduce it is for certain. If we don't or can't reduce this difference, control will be impaired, and health at one or more of the biological, psychological, or social levels will be compromised.

In order to create more harmonious social environments, we need to find ways for the controllers in any particular social setting to be able to control the things that are important to them without preventing other controllers from doing the same thing. Our most challenging and intractable social problems arise when some controllers prevent other controllers from controlling. This occurs not only between individuals, but between families, clubs, groups, communities, towns, and even countries.

When we understand ourselves and others as controllers, we can recognize how futile it is to suggest to people they should not control. Certainly, the things that people control can be objectionable or counterproductive, but the fact that they control is immutable. Perhaps it would help individuals if they recognized that when they are feeling disgruntled or otherwise out of sorts, it is because there's a nagging difference between what they want and what they're getting.

Contentment will only return when this difference is reduced somehow. The difference can be reduced by either changing what you're getting or changing what you want. The way it is reduced doesn't matter as much as the fact that it is reduced. This sentiment is summed up by the ideas of getting what you want and wanting what you get!

Control is what we do all day every day, day in, day out, year after year until we've done all of our doing. By understanding ourselves and each other as controllers, and gaining an inkling into how control works, we might discover that the best thing we can do to enhance our own controlling is to help others with their controlling. We perhaps can't even imagine yet how wonderful it will be to arrive at that place.

By Timothy Carey, PhD
Author: *The Method of Levels—How to do Psychotherapy Without Getting in the Way*
Vice President, Australian Psychological Society
Enjoy Tim's easy-to-read, thought-provoking blog:
www.psychologytoday.com/us/blog/in-control

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

www.livingcontrolsystems.com/demos/tutor_pct.html
This web page features demos and simulations for DOS and Windows. Be sure to read the first pdf, *Running PCT Demos*, and note the need for emulation software to run DOS programs with recent versions of Windows. With a Windows XP computer, you can run DOS programs directly.

www.pct-labs.com/
Adam Matić's demo programs for your browser are Java versions of Powers' original DOS programs shown above, with more conversions to come.

www.mindreadings.com/demos.htm
This web page features Rick Marken's demo programs for your browser. Here are 19 interactive demos. The Baseball Catch Simulation is documented in *Doing Research on Purpose*, page 97. The Spreadsheet Simulation of a Hierarchy of Control Systems (a download) demonstrates the counter-intuitive phenomenon that the same few lower-level control systems can satisfy divergent higher level control systems at the same time. See also *Mind Readings,* page 133.

Books focusing on demonstrations

Living Control Systems III (the entire book)
People as Living Things (chapters 6, 7, 8, 9, 13, and 18. Note page 211)
Introduction to Modern Psychology (page 21)
Management and Leadership (pages 51 ff and 27 ff – in this volume)
Dialogue Concerning the Two Chief Approaches... (page xxvii, right column)

Papers in this volume where demonstrations and robots are discussed

BYTE Articles—The Nature of Robots
Running PCT Programs

Special issue of Closed Loop

Portable PCT Demonstrations. Volume 3, Number 2, Spring 1993.
http://www.pctresources.com/Journals/Files/Closed_Loop/

Websites featuring robots

Robots implemented in software and hardware
Rupert Young: **www.perceptualrobots.com/**
Richard Kennaway **www2.cmp.uea.ac.uk/~jrk/**
For Kennaway's site, note ***Perceptual control theory and robotics*** as well as ***Real-time procedural humanoid animation***, also an application of PCT

YouTube video featuring robots based on PCT

Rupert Young: **www.tinyurl.com/RupertRobots**
Adam Matić **www.tinyurl.com/AdamRobots**

From *Perceptual Control Theory: An Overview of the Third Grand Theory in Psychology. Introductions, Readings, and Resources*. Page xi. Dag Forssell, ed (2016)

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 of S's. E should make sure that S is not holding his or her arm limp. E then gives a sudden sharp downward push, and S's arm appears to rebound as if on a spring. An electromyograph verifies that this is an active, innervated correction, not simply muscle elasticity. The initial position of S's arm makes no difference, and the initial muscle tensions involved also make no difference. S can be asked to hold his or her arm in a different position, and the control action will be the same, showing that the reference signal for the system can be altered and the system will continue to correct its action to the new reference setting.

Second-Order Systems derive their feedback signals from sets of first-order feedback signals. We call this level of control, or second-order feedback (f-2), "elementary sensations," since it represents the initial grouping of first-order (f-1) signals into elements with characteristic sensory patterns. In the kinesthetic modality, there would be signals representing muscle stretch, joint angle, tendon tension, and internal tissue pressure—which add up to the elementary sensations of effort, as when you clench your fist. To demonstrate this order, E now instructs S to extend his or her hand as before and E again places his or her hand on top. Now E tells S to swing his or her arm downward as rapidly as possible, as soon as he or she feels E's downward push. E's hand must be in contact with S's to make the push as sharp and unexpected as possible. Immediately upon the push, S's first-order systems return his or her arm to its initial position, because they act within the latent period of the second-order feedback signal. The initial correction is nearly completed before the second order resets the reference signal.

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. Now, however, E extends his or her other hand, holding out his or her index finger, instructing S to swing his or her arm over to touch the index finger to E's upon the signal. At the instant of the push, E shifts his or her target finger 4 or 5 inches from its initial position. The first two orders of action remain visible, and at the end of S's rapid swing, a third phase can be seen. S's finger comes nearly to a stop where E's finger was, and then shows a much slower corrective movement which is noticeably different from the first two actions. The second-order systems achieve their goal states much more quickly than third-order systems—so quickly that under appropriate circumstances they actually have to wait for the next reference signal from the controlling third-order system.

Fourth-Order Control is the control of transitions between different static configurations. E instructs S to extend an index finger and track E's extended index finger. E then moves his or her own finger in a circle 8 to 12 inches in diameter, gradually speeding up. You can notice S first tracing a jagged path while attempting to match E's position, until he or she experiences the regularity of E's movement—at which point S's action smooths into the appropriate circular pattern; he or she has set the reference level of a fourth-order system. The variables of this level are called transition control variables.

Studying behavior within the control-theory paradigm is a different process from that of traditional psychology. Instead of describing an activity of interest to the experimenter (often arbitrarily chosen) and then creating theoretical explanations independently of explanations in other areas of psychology, we first need to present the control-theory model as a whole. Then we shall be able to examine each level of behavior in relation to the others and use comparable rather than incomparable terminology in studying them. The above demonstration comprises a prelude to this process.

From *Introduction to Modern Psychology — The Control Theory View*, p 21. Robertson and Powers (1990)