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)
This 423–page book is a free pdf download at www.livingcontrolsystems.com
It holds 8 pages listing resources, 34 short papers, and info on 26 books, most with sample chapters.

Demonstrating Perceptual Control Theory (PCT) — Insight into how we function

To learn more...
www.iapct.org
(International Association PCT)
www.livingcontrolsystems.com
(Book of Readings and Resources, this presentation and more)

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)