Perceptual Control Theory:

A Model for Understanding the Mechanisms and Phenomena of Control

Abstract

Perceptual Control Theory (PCT) provides a general theory of functioning for organisms. At the conceptual core of the theory is the observation that living things control the perceived environment by means of their behavior. Consequently, the phenomenon of control takes center stage in PCT, with the epiphenomena of behavior playing an important but supporting role. The first part of the paper explains how a negative feedback control system works. This explanation includes the basic equation from which one can see what is required for control to be possible. The second part of the paper describes demonstrations that the reader can download from the Internet and run, so as to learn the basics of control by experiencing and verifying the phenomenon directly. The third part of the paper shows the application of PCT to psychological research, learning and development, conflict, and psychotherapy. This summary of the current state of the field celebrates the 50th Anniversary of the first major publication in PCT (Powers, Clark & MacFarland, 1960).

Key words: Nature of control, Control theory, Control of perception, Negative Feedback, Computer Models, Conflict and control

William T. Powers — *Lafayette, Colorado, USA*

Bruce Abbott — *Indiana University – Purdue University Fort Wayne, Fort Wayne, Indiana, USA*

Timothy A. Carey — *Centre for Remote Health and Central Australian Mental Health Service Centre for Remote Health, Flinders University and Charles Darwin University, Alice Springs, Australia*

David M. Goldstein — *General Practice of Psychology and Biofeedback, Moorestown, New Jersey, USA*

Warren Mansell — *University of Manchester, Manchester, UK*

Richard S. Marken — *Department of Psychology, University of California, Los Angeles, USA*

Bruce Nevin — *Cisco Systems, Inc. Edgartown, MA, USA*

Richard Robertson — *Department of Psychology, Northeastern Illinois University, USA*

Martin Taylor — *Martin Taylor Consulting, Toronto, Ontario, Canada*

This survey of the field of psychology was created as a collaborative project in 2010–2011.
For an email discussing this document, see page 17. Originally posted at pctweb.org in 2011.
Fig 1 redrawn for clarity, document reformatted, and email added by Dag Forssell, May 2014.

The phenomenon of control

The phenomenon of control is important in Psychology. Even a cursory glance through academic journals reveals a large number of references to the term 'control', as exemplified by E. A. Skinner (1996). Terms such as *perceived control, locus of control, cognitive control, subjective control,* and *vicarious control* speak directly to the phenomenon. If we include implicit references to control, such as self-determination, self-regulation, agency, learned helplessness, and emotion regulation, the number of references grows exponentially.

Although the importance of control in the process of living has long been recognized, this recognition is divorced from any broadly accepted formal understanding of how control works. Such a conceptual framework is essential first because without it the principles of control evade intuition, and second because, unless intuition has been adjusted to the facts of control, an encounter with a control system in action almost inevitably results in misinterpretation of what it is doing and how it works. The purpose of this paper is to present a summary of the current state of Perceptual Control Theory (PCT), which provides a conceptual framework for understanding the facts and mechanisms of control.

The phenomenon of control is familiar from the behavior of artificial devices such as the thermostat. The thermostat acts to keep a variable, room temperature, in a pre-determined state (the temperature setting of the thermostat), despite disturbances (such as changes in outside temperature and the number of people in the room) that would act to move that variable from the predetermined state. In the behavior of living organisms control is seen as purposeful or goal-oriented: the organism is seen acting to bring some variable state of the world, such as one's relationship with another person, to a pre-determined state (marriage) despite disturbances (such as disapproving parents and/ or competing suitors).

Perceptual Control Theory (PCT): A theory of control

There are three steps to learning PCT. The first, and perhaps the most difficult, is to grasp just how different this sort of organization is from cause-effect (input-output, stimulus-response, open loop) systems. The second step is to experience control systems in action—control systems inside the person who is doing the learning. And the third step is to learn to see the parallels between the abstract model and a real living system. We start by looking briefly at an abstract model of a control system that will be revisited throughout the article.

Step 1: Organization and properties of a negative feedback control system

Negative feedback control, first formalized by engineers in the 1930s, entered psychology through engineering psychology and the cybernetic movement of the 1940s and '50s (Ashby, 1952; Miller, Galanter & Pribram, 1960; Wiener, 1948;). The similarities, and important differences, between these systems and those used in PCT have been explained elsewhere (Powers, 1992). The system used in PCT will be explained here. A single isolated negative feedback control system can be represented as a two-part block diagram. One part shows variables and relationships that can be observed from outside the system-a model of the environment with which the control system interacts, including quantitative measurements of those interactions. The remainder of the model is essentially a proposal for what sorts of functions and variables might exist inside the controlling entity that would account for what we can see it doing from outside. The spirit of this model is the same as in physics and chemistry. It is a proposal for the existence of unseen entities and laws relating them-in physics the unseen entities include things like an electron, a field, or energy. The model is stated so one can use it to make predictions, and the requirement for accepting the model is that predictions be confirmed by experiment and observation to the limits of measurement. That is an ambitious goal and we do not claim more than to have set foot on that path. But that is the intent and the guiding principle behind PCT.

Figure 1 shows the 'canonical' PCT model of a single negative feedback control system[1] in relation to an environment.

---

1 The full model is built from many systems like this operating in parallel and arranged in layers, a hierarchy of concurrent control in many dimensions.

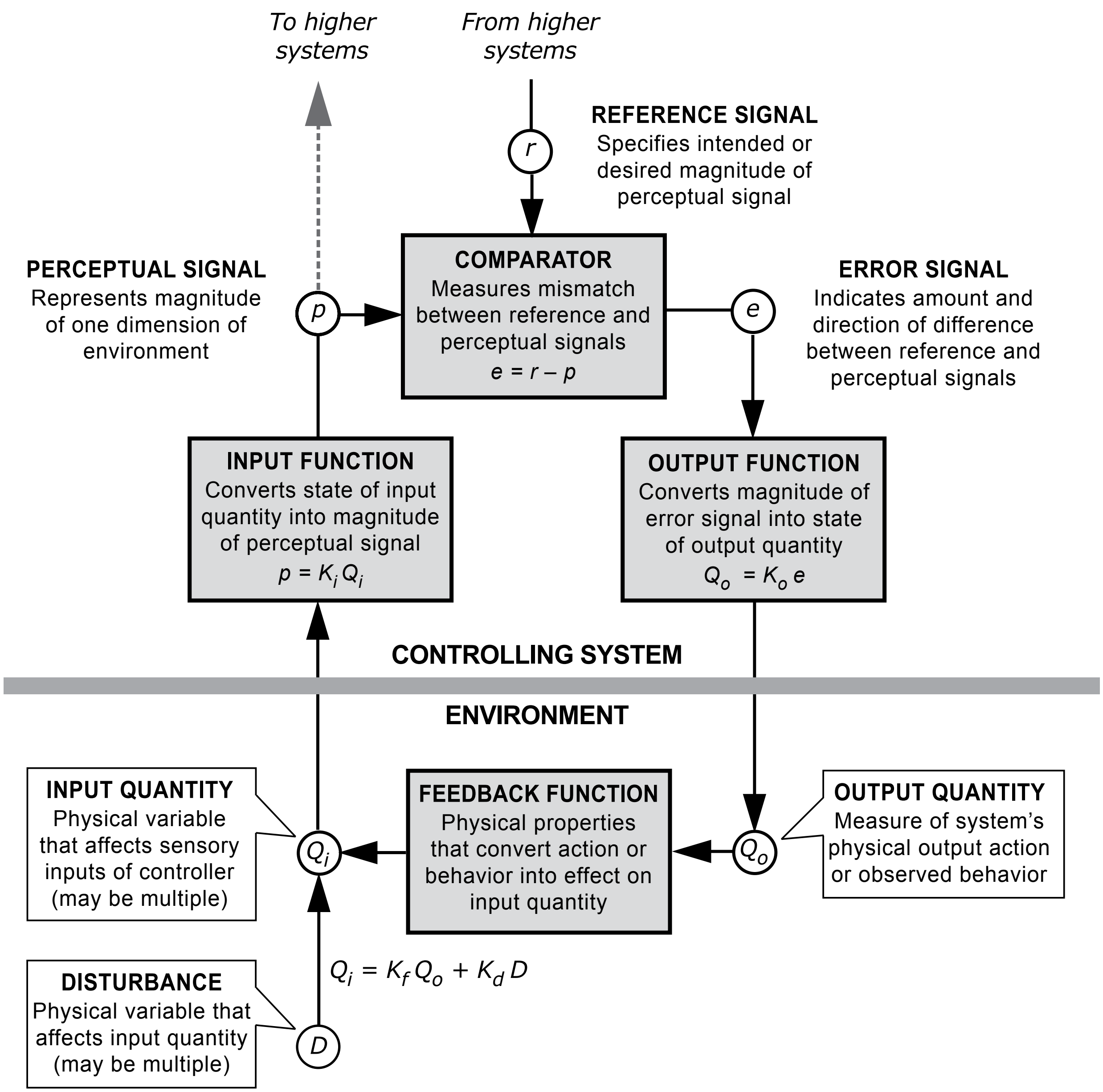

Figure 1: The basic organization of a negative feedback control system. Loop functions are shown in gray. Variables D, Q_i, *etc. are employed in the fundamental algebraic equations of negative feedback control theory, as described in the text. The reader is invited to explore the functions and relationships interactively in the Live Block demo (one of the LCS3Programs set—see the Resources section below).*

There are two independent variables, the reference signal and the disturbance. The first task is to work out the properties of this organization in its simplest form, which is the steady state attained when these two variables are held constant.

A small dose of algebra will help here. Each main component of the system is represented by an equation showing, to a first approximation, how the output of that component depends on its input in the steady state.

Starting with the input quantity (Q_i) in Figure 1 and going around the closed loop, we represent the input-output function in each box as a simple linear equation:

(1)	$p = K_i Q_i$	— input function
(2)	$e = r - p$	— comparator
(3)	$Q_o = K_o e$	— output function
(4)	$Q_i = K_f Q_o + K_d D$	— feedback and disturbance functions

where p = perceptual signal, r = reference signal, e = error signal, Q_i = input quantity, Q_o = output quantity, D = disturbance, and K in each case (K_i, K_o, K_f, K_d) is a constant converting amount of input to amount of output at each of the indicated points in the loop. The largest increase in output occurs in the output function, where very weak neural signals are converted to as much as hundreds of pounds of muscle force.

The four numbered statements above describe how the output of each function depends on its input or inputs. In the simplest case, when the disturbance and the reference signal are constant, the whole system, if properly designed, comes into a state of balance which can be found by solving the simultaneous equations for variables of interest. Solving for the perceptual signal p by successive substitutions yields

$$p = K_i K_o K_f (r - p) + K_i K_d D$$

The product (K_i, K_o, K_f) is the 'loop gain', representing how much a signal affects itself through the feedback loop. Substituting $G = K_i K_o K_f$ to represent loop gain, we obtain

$$(5)\quad p = \frac{G}{1+G}\, r + \frac{K_i K_d D}{1+G}$$

As the loop gain becomes larger (and the addition of 1 becomes less significant), the ratio $G/(1+G)$ approaches 1 and becomes progressively less sensitive to changes in G.

The higher the loop gain, the more precisely the control system makes the value of the perceptual signal match the value of the reference signal, even with disturbances interfering.

Equation (5) is the most important equation in this theory about living control systems. If $G = \infty$, then[2] $p = r$: the reference signal determines the perceptual signal, disturbances have no effect, and large variations in loop gain have no effect on performance. If $K_f = 0$ (no feedback) then $G = 0$ and $p = K_i K_d D$. That is, the perceptual signal is determined entirely by the disturbance. When system dynamics are considered, the equations become more complex, but the steady-state equations remain true. The steady state, or very slow changes, can be understood correctly in this relatively simple way.

Knowing that Q_i is nearly constant when loop gain is high, we can use Equation 4 to see how the output action is related to disturbances. ΔD, a change in the disturbance D, results in ΔQ_o, an opposing change in the output Q_o.

$$(6)\quad K_f \Delta Q_o = -K_d \Delta D$$

A change in the disturbance results in a change in the effect of the output on Q_i that is opposite and almost equal to the effect that this change in the disturbance has on the same variable.

Thus the relationship of the response (output) to the stimulus (input) is determined primarily by the two environmental constants K_d and K_f, not by the actual input-output characteristics of the control system. This may be verified in the Live Block demo previously mentioned (see the LC3Programs link in the Resources section). We call this effect the 'behavioral illusion' because it explains how it has been possible for so long to mistake a control system for an input-output or stimulus-response system.

H.S. Black of Bell Labs, traveling to work aboard the Lackawanna Ferry on the morning of August 2, 1927, suddenly realized how negative feedback could (as outlined above) make telephone relay amplifiers almost immune to changes in vacuum-tube characteristics and erase the nonlinearities of their characteristic curves, while greatly increasing the bandwidth of uniform response (Black, 1934, 1977). High-fidelity audio amplifiers were one result, now familiar, of this insight. Another, less well known but ultimately much more important, was the development of the field of control system engineering—which, by way of cybernetics, led to PCT.

In sum, behavior is the externally visible aspect of a control process by which perceptual experiences are controlled.

We control perceived results, not behaviors or actions. Behavior is the control of perception.

2 More exactly, r is the limit of p as G approaches infinity.

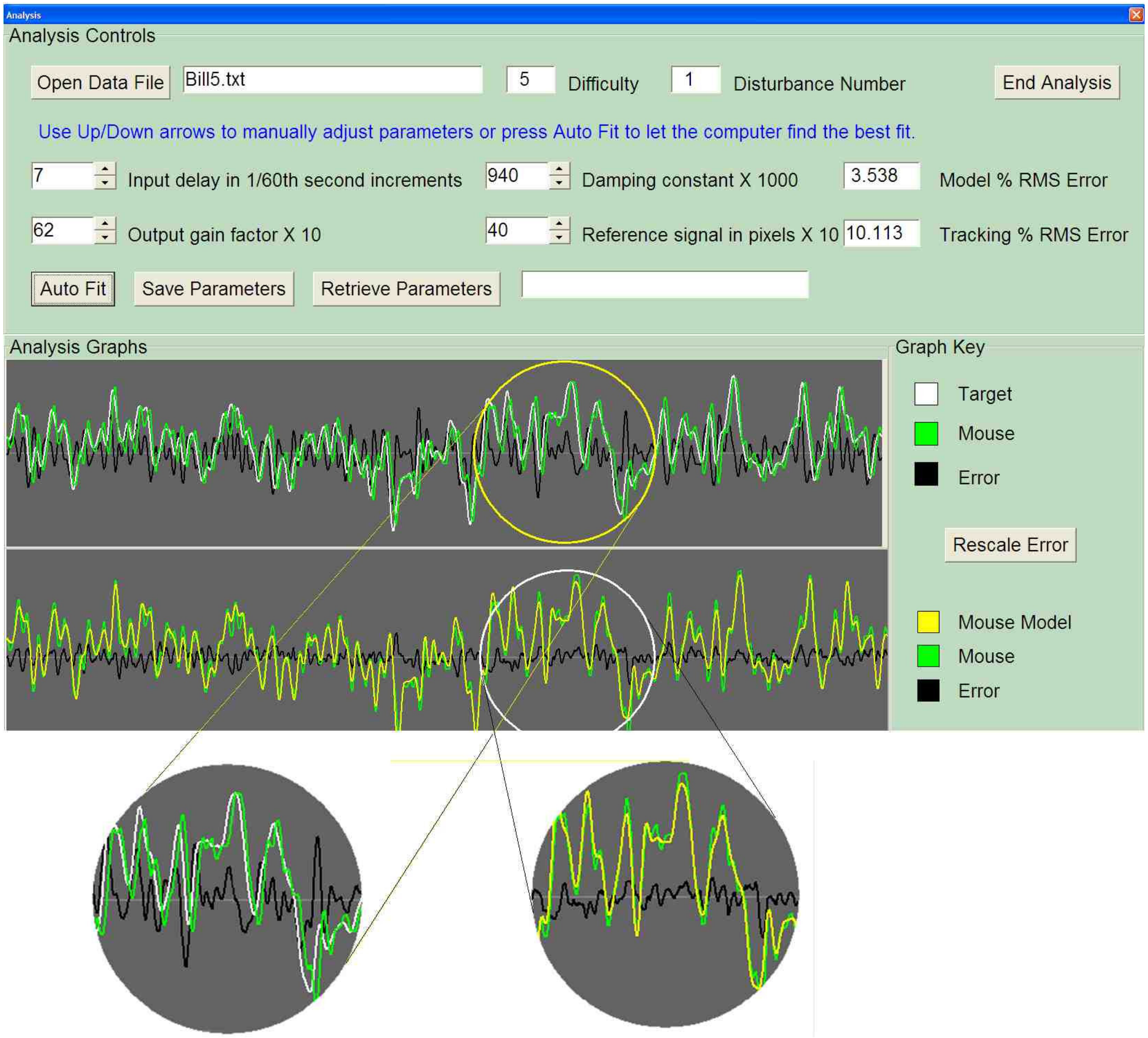

Figure 2. Analysis of human tracking run and fit of negative feedback control model to the data. Upper traces: experimental results; lower traces, match of model (yellow) to the real mouse movements (green). Expanded views taken from each trace are shown to facilitate the comparison. Note delay of human's mouse (green) behind target movements (white).

Step 2: Demonstrations of negative feedback control

We turn now to the phenomena of control. In the Resources section at the end of this paper are some links to the Internet through which the reader can download several programs that provide interactive demonstrations of control phenomena produced by living control systems within the reader.

There are two sets of demonstrations that can be downloaded and run on a PC,[3] the Demo3 set and the LCS3Programs set. The Demo3 set is a tutorial in PCT with its own narration, which the reader may want to try right now: it will be helpful.

3 As of this writing, you must use a Windows XP emulation program to run these demos on a Macintosh.

The other, LCS3Programs, is a set of 13 demonstration programs that are part of a book (Powers, 2008) but which can be downloaded and run without the book. We highly recommend experiencing the interactive programs. The abstractions in the model will take on much more meaning when connected to direct experience of the phenomena that they describe.

The LCS3Programs set, after installation (following instructions on the download page), is started by clicking on a desktop icon with a red ball on it. The first that we will examine is called ***Demo 4-1, TrackAnalyze*** on the menu which appears at startup. Practice with it for a bit, then follow the instructions to collect data for a formal one-minute run, and then analyze it, using the ***Auto Fit*** button to find the best parameters automatically. The result of the analysis will be a window that looks like Figure 2.

The upper plot shows the target (red) and mouse (green) positions. The black trace is the point-by-point difference between them, the tracking error, which for this 1-minute run was 10% (RMS) of the range of target movement. The lower plot shows how the model's behavior compares with the person's. The error of fit of the model's behavior to the real behavior (labeled "Model % RMS Error"), is 3.6% of the target's range. Since that is less than half of the tracking error, the model must be approximating some of the tracking errors the real person made.

This model inserts a time delay between input and output, called a transport lag, which is optimized by the analysis program. The best-fit value usually comes out to about $8/60^{th}$ of a second, or about 133 milliseconds (7 to 9 frames of the display screen running at 60 frames per second). With this delay fixed at zero, the 3.6% best-fit error grows to 6%, so we may conclude that the delay is real. Starting a few years after the first tracking experiments were done by engineering psychologists in the 1940s and 1950s, there have been persistent rumors that "feedback is too slow" to be used in behavioral models (e.g. Lashley, 1960), and an apparent conviction that with high loop gains feedback systems with even small delays would become violently unstable. Clearly nothing like that occurs here, either in the negative feedback control model or in the human being. A feedback model with parameters properly chosen, including delays, is exactly fast enough—neither faster nor slower than the real human behavior.

Beyond Tracking

PCT is relevant not just to tracking but to all behavior that involves control—and a careful look suggests that all behavior involves control (Carver, C.S. & Scheier, 1998; Marken, 1988; 2002; McClelland and Fararo, 2006). The loop variables seen in the tracking task can be seen in any example of everyday behavior, from eating breakfast in the morning to brushing one's teeth at night. In each of these behaviors there are controlled variables (like the distance between cursor and target in the tracking task), references for the state of these variables (corresponding to the cursor being aligned with the target), disturbances that would move these controlled variables from their reference states (corresponding to the random variations in target position) and actions that bring the controlled variables to these reference state and keep them there, protected from disturbance (as the mouse movements keep the cursor on target).

Non-tracking demonstrations of control can be found in the LCS3Programs series. The first shows a red ball that is being disturbed in three ways: its position wanders from side to side, its shape varies from tall and thin to short and wide, and its 'north pole' changes orientation as the ball rocks upward and downward. The three disturbances causing these changes have very low correlations with each other. The participant moves a slider with the mouse, affecting all three aspects of the ball equally and simultaneously. The task is to pick one aspect and hold it constant for one minute: either the lateral position *centered*, or the shape *round*, or the orientation of the pole *pointing toward you*.

After the experimental run, three correlations are calculated among these variables for each plot. The computer indicates by a yellow highlight which of the aspects was under intentional control. It is almost never wrong. Contrary to intuition, the mouse position correlates best with the two uncontrolled aspects of the ball. Figuring out why this is true is a good test of understanding PCT.

Possibly the most surprising demonstration in terms of showing what is meant by control of perception, is ***Demo 9-1, SquareCircle.*** The participant employs the mouse to move a white dot so that it traces as accurately as possible around all four sides of a red rectangle. After the tracing is done, typing 'v' changes the view to show the path that the mouse followed. It is an almost perfect circle (Figure 3, below). The feedback function (see Figure 1) is such as to transform a mouse position relative to the radius of a reference circle into a similar position along a radius from the center of the rectangle to its periphery[4].

But participants are never aware that they are moving the mouse in a circle; they think they are moving it—with some small difficulties—in a rectangular path as shown by the white dot. This impression remains even when they know the truth.[5] Behavior is a process of controlling perceptions, not actions. The actions automatically become whatever they must be to produce the intended perceptual result[6].

Hierarchical PCT (HPCT)

There are two kinds of hierarchical control. One can be called the 'what-why-how' kind and provides a relatively atheoretical way of analyzing behavior into levels. The other is similar but involves a more general analysis. The first kind can be seen in a familiar situation.

You notice someone with a finger on a button beside a door. You ask yourself: "What is he doing?" and the answer seems simple: "He's ringing the doorbell". That is *what* the person is doing. But this is only a means to some end, which we can see if we ask *why* he is ringing the doorbell. Maybe he is visiting and wants Aunt Mary to open the door. Maybe he is promoting a candidate in an upcoming election. Maybe he is delivering pamphlets. Although the *why* is obscure to an observer (but not to the doorbell ringer), the *how* of the observed behavior is clearly "by pressing the doorbell button". However, even this *how* has its own 'what-why-how' pattern. *What* is "seeing and feeling my finger pushing the button", *why* is "to make the bell ring" and *how* is "by moving my hand and arm to the appropriate place". These possibilities illustrate the point demonstrated a few paragraphs ago: the action we see a person producing is generally different from

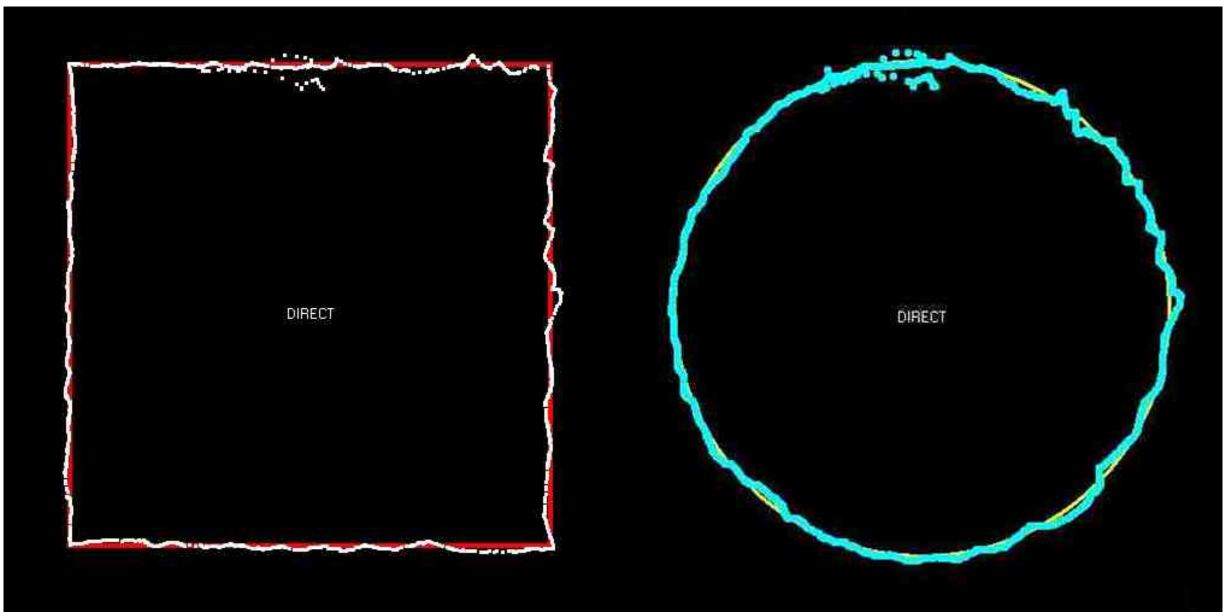

Figure 3. Participant used mouse to move white dot so as to trace red square (left). Mouse actually moved in a circle, as revealed (right) on typing 'v' after the tracing is finished.

4 You should type a 'd' before doing the tracing, to select the simplest ('direct') form of feedback function

5 There is a similar persuasiveness of illusion in the McGurk effect, the subject of much inconclusive research since McGurk & MacDonald (1976).

6 Typing a 't' makes the reference figure, and the mouse movements, into a triangle ('c' makes it a circle). The mouse path is obvious to an onlooker in either case.

the static or dynamic controlled variable that the person is using the action to control, whether we are looking at the details or the larger picture.

There seems to be a hierarchy of goals here, but what we are seeing so far is a perceived principle, the what-why-how principle, being applied over and over to smaller and larger subdivisions of one complex overall control process. We understand the result by using our capacity to perceive logic, principles, and concepts about systematic order in the world. And those words are showing us something quite different from the what-why-how principle. We have *logic*. We have *principles.* We have a *system concept*. These are the top three levels of perception currently being proposed—tentatively—in PCT. How are those classes of perceptions related to each other? Asking those questions is how we uncover an underlying hierarchy of (proposed) *kinds* of control systems in the brain.

The Second Law of Thermodynamics, conservation of momentum, and Newton's Law of Gravitation are among the principles perceived as adding up to the system concept we call 'physics'. Likewise for different sets of principles that add up to government, economics, religion, society, self, and Mom. Peter Burke (2007) sees system concepts like these in terms of 'identity control'. To support a given system concept, one must vary the reference levels for an appropriate set of principles. To achieve a perception that a principle is present to a desired degree, it is necessary for principle-level systems to vary reference levels specifying which programs are to be perceived in progress. The language gets a little clumsy but the idea may still be understood.

The general idea is that each perceptual signal at one level in the hierarchy is a function of multiple perceptions at a lower level. Control of a perception at one level requires adjustment of reference signals sent to lower systems, which control the perceptions on which the state of the higher-level perception depends. This general organization of the hierarchy of control is the system concept that is called 'hierarchical PCT' or HPCT.

The PCT hierarchy had its beginnings in the 1950s at the lowest levels of all, currently termed *intensity*, *sensation*, and *configuration*. The need for a hierarchy showed up immediately when the spinal reflexes were first recognized as control systems. A spinal reflex (exemplified by the knee-jerk reflex) automatically resists any disturbance of its input variable. But how can the systems higher in the brain use the motor outputs if the spinal control systems automatically react against changes in limb positions or muscle lengths or tendon tensions, and so on? Do we need some elaborate and completely *ad hoc* system that turns the reflexes off when higher systems want to use the muscles, then back on?[7]

Once it is realized that a reflex fits the description in Figure 1, the answer becomes as obvious as the problem was. The simplest way a center higher in the brain can change the controlled variable (without employing violence) is to alter the reference signal. Thus we arrive at the basic principle of hierarchical control, which applies equally well at any level from the spinal reflex to cortical reflection on the state of the world. A control system at any level senses and controls a perception of the type that is supported by that level of brain or nervous system organization. It does so not by commanding the muscles to twitch, but by telling systems at the next level down how much of the perceptions that they control they are to produce. Only at the lowest level, the tendon reflex, do the control systems control their own perceptions by generating muscle forces that affect the outside world. HPCT proposes a mechanism by which specifying reference signals for the level below can turn a goal at the highest level, stage by stage, into the specific muscle actions that achieve it.

The main levels currently proposed are named the *intensity*, *sensation*, *configuration*, *transition*, *event*, *relationship*, *category*, *sequence*, *program*, *principle*, and *system concept*. There may be subdivisions within these categories. Despite having been formulated and revised and worked over for more than 50 years, they are still tentative and subject to more revisions (especially the highest current level). But under the present definitions (Powers, 1998) the basic concept is illustrated and the definitions have proven useful (e.g. van de Rijt & Plooij, 2010).

The higher levels of perception take more time than the lower to be recognized, but in the end all levels of perception are occurring at the same time.

7 At the same time that PCT was first being described, the Russian physiologist Nicolai Bernstein wrote about this problem (Bernstein, 1967).

Because they form an integrated picture of conscious experience, sorting the experience into its constituent perceptions takes some practice. The originators of PCT took seven years to notice and formalize just five levels (Powers et al., 1960).

For experience with levels, the reader is referred to Marken's demonstrations:

mindreadings.com/ControlDemo/Levels.html
mindreadings.com/ControlDemo/HP.html

Reorganization

The eleven proposed levels of control systems within people are not all present at birth, but it is proposed that their development is well under way by the end of infancy (van de Rijt & Plooij, 2010). They are proposed to result from a change process referred to as 'reorganization', acting on pre-existing structures in the brain that, we assume, have evolved to favor the development of the various types of controlled variables. The 'Ecoli' demonstration in the LCS3Programs set enables you to experience the mechanism that PCT has adopted for the process of reorganization. Reorganization is the unifying concept used to explain how new control systems come into being and how old ones are changed.

In the first paper that led to PCT, a 'negentropy' system was proposed as the origin of reorganization (Powers et al., 1960). It was patterned after a proposal by the cyberneticist W. Ross Ashby (1952) to account for the basic kind of learning called 'trial and error.' It is the only option available to an organism before the time that systematic processes become organized. Powers et al. adopted Ashby's idea that random changes in system parameters might begin when 'intrinsic' controlled variables (Ashby's 'essential' variables) deviate from genetically specified reference levels. These changes of organization continue as long as 'intrinsic error' persists, stopping only when some control-system organization results that brings the intrinsic/essential variable close to its reference level again and keeps it there against disturbances. The processes involved act like an odd sort of control system, now called the *reorganizing system*, that controls by producing random variations of neural organization.

This is the polar opposite of the concept of reinforcement as introduced by Thorndike (1927) and elaborated by B. F. Skinner (e.g. Skinner, 1969). Under reinforcement theory, when an animal produces a behavior that has a beneficial consequence, the organism behaves that way more often. Reorganization theory says that a *lack* of something beneficial gives rise to *continuing changes* in the internal organization of control systems in the organism, changes which slow down when the latest reorganization results in behavior that reduces the deficit. When intrinsic error is reduced enough, reorganization stops and the behavioral organization then in effect persists; the organism keeps controlling the same perceptions in the same way.

PCT proposes that behavior is not what is learned. Instead, a control system is acquired or modified. The behavior that corrects intrinsic error can involve both specific actions and their exact opposites. As shown clearly in the Demo3 set of demonstrations, control can be learned and improved even when a different pattern of behavior is required every time a given control action is successfully executed. A control system, simply because of its underlying organization, automatically varies its actions as disturbances come and go, without needing any warning or any prior experience with each new pattern—one of the great advantages of negative feedback control over other kinds of control.

B. F. Skinner defined 'the operant' as any behavior that produces a reinforcer. But because he eschewed models of what happens inside an organism, and Ashby had not yet demonstrated the principle behind reorganization, he did not realize that there was an alternative to reinforcing both a specific action and some unrelated action, even the exact opposite. A reinforcer produced by pressing down on a lever with the left paw should increase the probability of pressing the lever with the left paw, yet the next lever-press may be accomplished by pressing the lever with the right paw (or even by backing into it!). How can the reinforcement of left-paw pressing increase the probabilities of these other, quite different behaviors? Defining these different behaviors as somehow the same because they have a common consequence (lever-depression) only obscures the problem rather than solving it. In PCT we are concerned with 'how' questions about what happens inside an organism, and our very different concept of what is learned accounts for the multiplicity of means to the same end for which B. F. Skinner tried to substitute 'the operant'. The LCS3Programs set of demonstrations includes a number of demonstrations of reorganization (Powers, 2008).

Step 3: Applications to selected topics

Methodology

According to PCT, all behavior from the simplest to the most complex is organized around the control of perception. Understanding behavior means knowing what perceptions are being controlled, how they are being controlled, and why. For instance, understanding the behavior of a fielder catching a fly ball means knowing that the fielder is controlling a perception of the optical position of the ball (*what*) by moving on the field appropriately (*how*) with the ultimate goal (*why*) of keeping the approaching ball at a constant or only slowly changing vertical and horizontal angular direction from the fielder until it is caught (Marken, 2001). Behavioral research in the PCT paradigm is, therefore, aimed at discovering what variables the system is controlling, how these variables are being kept under control, and why. The *what* question is always the main focus of PCT research, and it is answered using a methodology known as *the test for the controlled variable* or simply *the test* (Powers 1973, 2005).

The test is based on the fact that a properly functioning control system acts to protect controlled perceptions from disturbances which, in the absence of control, could move these perceptions from their reference states. The test starts by inventing hypotheses about what perception might be under control. Hypotheses about controlled variables come from trying to see the behavior from the organism's perspective. For example, when a beaver is seen to be building a dam one might hypothesize, risking a far-fetched guess, that the beaver is trying to diminish the noise level of the water flow. If the loudness of that noise is a controlled variable for the beaver, the beaver will do something to bring loudness to whatever reference level the beaver sets. If the reference level is zero, then any nonzero sound intensity constitutes a disturbance. The hypothesis is tested by applying disturbances that will be resisted if the hypothesized perception is being controlled. In the beaver example, a research program was indeed carried out in which the researchers produced the sound of rushing water from a loudspeaker near the beavers (Richard, 1983). If the noise were not what is being controlled then the beavers would behave the same way with or without the noise; the disturbance would not be resisted. In fact, the beavers did resist the noise disturbance by piling mud on the source of the noise, suggesting that beavers do control (among other perceptions) the sound of rushing water, keeping that variable as close to zero as possible. It's not hard to imagine why.

The disturbance is the independent variable in the test for the controlled variable. The dependent variable is typically the state of the hypothetical controlled variable itself. So the test is conducted in the same way as in conventional behavioral research; the researcher manipulates an independent variable and measures concomitant variation in a dependent variable. But in this kind of test, observation of a predicted effect of the independent variable on the dependent variable is a negative result, because it indicates that the dependent variable is not being controlled. Conversely, if behavior cancels any effect that does start to occur then the dependent variable (the hypothetical controlled variable) is likely to be under control. If, for example, an increase in the sound of rushing water leads to actions that keep this sound at zero, it is evidence that the sound of rushing water is a controlled variable with an apparent reference of zero loudness. In this we see several ways in which research in the PCT paradigm differs from conventional research.

1. The test focuses on identifying control systems through the discovery of controlled variables. The test can apply to higher level (e.g., self-image) as well as lower level perceptual variables (Robertson et al. 1999).
2. The test focuses on the behavior of one individual at a time. This approach to research has been called 'testing specimens' to distinguish it from 'casting nets', which focuses on the study of groups (Runkel, 2007). For individual prediction accuracy, Kennaway (1997) has shown the importance of obtaining much larger correlation coefficients than those considered strong in Psychology.
3. The results of research using the test are validated using modeling techniques, like those described in Step 2, which is receiving more support in Psychology (Rodgers, 2010).

Learning and development

We have looked at the PCT model of the reorganization system. Though it applies to other kinds of learning, such as observational learning (Bandura et al., 1966) and verbal learning, we will discuss how reorganization may be the basic phenomenon behind the two most widely accepted concepts of learning, classical conditioning and operant conditioning,

Classical conditioning

Pavlovian or classical conditioning begins, we propose, with an existing control process, either learned or inherited (a 'reflex'). Consider thermoregulation. The controlled variable is the sensed temperature in the hypothalamus. If that core temperature drops, shivering starts, and as that activity warms the bloodstream and the internal temperature receptors, the shivering eventually slows or stops. This is a basic control system, probably inherited. The controlled variable is core temperature; the disturbance is heat loss that causes the core temperature to deviate from its (inherited) reference level, and the output variable is shivering that counteracts the heat loss.

The general PCT explanation of classical conditioning starts with deviation of a critical kind of controlled variable such as core body temperature from its reference level. The initial deviation, an 'intrinsic error signal', if not immediately corrected, is detected by an hypothesized reorganizing system's comparator (it could be a distributed property of all neural control systems), which starts random changes in neural connections, perhaps similar to the synaptic changes often proposed for Hebbian learning (Hebb, 1949). Suppose that some otherwise neutral stimulus such as cold air blowing on the skin happens to precede the change in the controlled variable by a few seconds. Neuroanatomy permitting, reorganization will eventually make a connection between the neutral perceptual signal and the input function of this control system. That neutral stimulus thus produces the same perceptual signal in the control system that would be produced by a change in the controlled variable, a drop in core temperature, but does so before the critical controlled variable actually changes enough to cause reorganization to start. When the cold air starts blowing, the revised control system will now detect an error and the error will cause the same action as usual, shivering, protecting the core temperature from the disturbance—but there will be no further reorganization because the next time the cold air is experienced, shivering starts immediately and the change in the intrinsic or essential variable, the drop in core temperature, does not occur, or is much less.

If now we arrange for a tone to precede the blowing of cold air on the skin, the same thing will happen again (once more, neuroanatomy permitting): if the shivering does not entirely counteract the effect of the cold air, reorganization will continue and the tone will eventually start the shivering even sooner, further reducing or eliminating the 'intrinsic error'. Rescorla has remarked that classical conditioning phenomena can be predicted by thinking of how a scientist recognizes causality—a regular relationship between antecedent and consequent (Rescorla, 1988). The model of reorganization that predicts classical conditioning—as well as extinction—is based on *actual* relationships between antecedents and consequents. But it does not rely on cognitive processes of recognition.

Operant conditioning

The same reorganizing process that creates the phenomena of classical conditioning can also explain operant conditioning. The main difference is that here reorganization appears to work more on the output side of the control system than the input side.

All the basic forms of operant conditioning, such as a fixed-ratio experiment, begin by restricting the organism's access to something important: food, water, or even warmth or sweetness. This is of course an error condition in some basic and presumably inherited control system. In Skinnerian terms, an animal subjected to this 'establishing condition' spontaneously 'emits' whatever behaviors have already been acquired or inherited that might lessen the deprivation.

Consider the case in which a rat is rewarded for lever-pressing by delivery of food pellets. Two different processes appear to be working here. The first one is simply an initial search for food and the narrowing of the search to any area where food was found. This is most probably an organized behavior that all rats learn, or it may be an innate behavior due to a control structure that they are born with. In the second process, the rat's accidental and then purposeful use of the lever to obtain food, it is the progressive refinement of the behavior pattern that makes it instrumental—reliable and organized to produce a specific effect in the given environment. Only the second process would require any change of internal organization.

Together, these two processes take place in what we may call the learning phase of a conditioning experiment. That phase is followed by a maintenance phase when the animal routinely uses the new technique to alleviate its hunger. The reorganizations in this kind of conditioning are primarily on the output side, where errors give rise to changes in the reference signals that are sent to this or that lower-order system that controls by means of already-organized behaviors.

Reinforcement is said to increase the probability of the behavior that produced it. This has a descriptive basis in observations during the learning phase of an experiment. Observation of what happens first in the operant cage shows, however, that it is the convergence of exploratory activities below, near, and above the lever that first increases the probability of producing the reinforcement. The PCT alternative to reinforcement theory, up to this point, is simply to say that this is normal control behavior. When the error is reduced, the tendency to go on exploring is decreased; when error is reduced enough, the exploring ceases.

Because this model leads us to expect essentially the same series of events that the theory of reinforcement suggests (albeit for different reasons), either theory accounts for the described facts for the initial learning phase. Simply having a plausible alternative to the theory of reinforcement, however, is useful in itself. It shows that reinforcement *is* a theory, not simply a description of a fact, and needs to be investigated as skeptically as any other theory.

By itself, reinforcement theory predicts that reinforcement leads to more behavior that generates more reinforcement. Considering only the basic principle of the theory, it would seem that if the rate of reinforcement increases, the behavior rate should also increase, or conversely should decrease noticeably if the rate of reinforcement decreases, and behavior should cease if the reinforcement completely stops.

It is true that complete cessation of reinforcement does result in extinction of behavior. However, changing the schedule of reinforcement to reduce the amount of reinforcement produced by the existing behavior rate does not reduce, but actually increases the amount of behavior, as the organism 'defends' its food intake, and ultimately its body weight. The behavior rate is increased just enough to maintain the reinforcement rate nearly constant. This increase in behavior rate is known as the *extinction burst*. It is not transient, as the word 'burst' suggests, but rather persists as long as behavior can maintain the desired food intake. Experiments with normal rats obtaining all their food by lever pressing (Collier *et. al*. 1986) showed that these animals maintain food intake at 20 to 25 grams per day even as the required behavior ranges from 20 presses to obtain a gram of food to 1000 presses per gram. In reinforcement theory, these observations are inexplicable; in PCT, they become easy to understand: it is behavior that maintains the reinforcement rate, not the other way around. The evidence above shows that reinforcement is actually controlled by behavior; it is simply one of many kinds of controlled input.

But such reinterpretations do not come easily to any science. Even physics once preferred a 'luminiferous ether' to the transmission of light through a vacuum, and chemistry once preferred the emission of phlogiston to the absorption of oxygen, until experimental evidence created an intellectual crisis. PCT, we hope, brings such an intellectual crisis to the sciences of behavior.

Conflict

The way a person's control systems are organized into levels with many independent control systems at the same level makes internal conflict possible, and indeed likely. Conflict arises when one control system receives disparate reference signals from more than one system at higher levels. For that one system where the contradiction occurs there is no problem; a virtual reference signal results and behavior matches perception to it. But neither of the higher systems gets the input it was requesting and both experience chronic errors. This effectively removes both higher control systems from useful service for still-higher systems, and the conflict may escalate (depending on details of organization), each system continually increasing its effort to resist the disturbance caused by the other.

Conflict within a person can arise quite by accident. A person may have a goal of being a good person. To be a good person, one should be steadfast, both consistent and firm; also, one should be supportive of others; obliging and accommodating. Both of these sub-goals are supposedly ways of satisfying the higher goal of being a good person. But when it comes to selecting a specific way of behaving that will satisfy both goals, the contradiction arises: one can't be steadfast and obliging at the same time, or firm while being accommodating too. At the level where a specific goal is to be achieved through specific programs, there is direct conflict. To behave one way means not behaving the other way. This sounds like a simple problem, and usually it is easy to resolve through some quick and automatic reorganization. But conflict can also be a serious problem leading to chronic difficulties: stay with an abusive mate for the sake of love and the children, and at the same time—an impossibility—leave, for the sake of sanity and safety.

Conflict between persons also interferes with positive social interactions. Cooperation requires several people acting to achieve a common goal. However, the more important the goal is (in technical terms, the higher the gain around the loop), and thus the smaller the errors the participants strive to eliminate, the more likely it is that conflicts will create problems. As participants' control becomes more skillful, a smaller discrepancy between their perceptions (or their goals) suffices to set them at odds with each other.

Another problem with between-persons conflict is that each person probably experiences internal conflict as a result of holding back from doing what would actually be necessary for prevailing over others in the details of goal-seeking. The urge to violence, as newscasts of parliamentary procedures occasionally illustrate, is not always easy to resist—and when it is resisted, a person loses some of his own goal-seeking skill. Conflict, whether intra- or inter-personal, can be crippling.

Clinical practice based on PCT is finding more and more evidence that serious unresolved conflict may be one of the primary reasons for psychological problems (Carey, 2008). Attention and reorganization tend to focus on the lowest level where conflicts are played out, but a conflict can be permanently resolved only by reorganizing on the levels where the contradictory goals are set. This suggests an approach to therapy that involves deliberate shifts in the focus of attention toward higher levels of organization.

PCT based psychotherapy: the Method of Levels

Psychotherapy has focused, understandably, on pathology. PCT contributes a useful perspective in understanding psychological disorders by first providing a model of satisfactory psychological functioning. Dysfunction then is disruption of successful control (Carey 2006, Mansell 2005). Distress is the experience that results from a person's inability to control important experiences. The symptoms of distress clearly cannot be 'treated' as though they were in themselves the problem. The PCT perspective is that restoring the ability to control eliminates the source of distress. As we noted earlier, conflict has the effect of denying control to both systems that are in conflict with each other. Conflict is usually transitory. It is when conflict is unresolved and becomes chronic that the symptoms recognized as psychological disorder become apparent.

As discussed earlier, chronically unreduced error triggers reorganization. When difficulty in controlling is due to more ordinary causes (environmental disturbance, inadequate perceptual input, inappropriate means, etc.), reorganization alters the control system in some way until control is restored (where that is possible). However, when error persists because two systems are specifying different goals for the same lower-order system, the lower system is 'frozen' in a state that satisfies neither of the higher systems that are locked in conflict.

There is evidence that attention tends to focus on this conflicted lower system. The subjective experience is of being 'stuck' and not knowing why. Nearly all schools of therapy assume that change requires being aware of what is to be changed. The general principle, in PCT, is that the main locus of reorganization seems to follow awareness.[8] The difficulty is that it is futile to reorganize the 'stuck' system; it is working properly.

8 It appears that awareness is *in* one level while focused *on* those lower levels where reorganization is also focused. Subjective attitudes and interpretations are perceptions on the level that awareness is *in*; the objects observed from that level (which those attitudes and interpretations are *about*) are the lower levels of perception.

No matter how it is changed, it still cannot satisfy two contradictory specifications of the goal it seeks; the best it can do is to seek a compromise goal, leaving both of the conflicting systems unable to achieve control. Instead of reorganizing the conflicted system at the lower level, one or both of the conflicting systems at the higher level must be changed so that they perceive differently or so that they use as means of control different lower-order variables that can be independently controlled at the same time. A shifting of attention is the key to doing this. Although reorganization is an automatic response to intrinsic error that cannot be controlled voluntarily, there is plentiful evidence that awareness can be redirected, and that this changes the focus of the reorganizing process. But the act of reorganization can be done only by the person experiencing the conflict.

The therapeutic approach that is based on the principles of PCT is called the Method of Levels (MOL; e.g. Carey, 2006; 2008). The core process is to redirect attention to the higher level control systems by recognizing 'background thoughts', bringing them into the foreground, and then being alert for more background thoughts[9] while the new foreground thoughts are explored. When the level-climbing process reaches an end state without encountering any conflicts, the need for therapy may have ended. When, however, this 'up-a-level' process bogs down, a conflict has probably surfaced, and the exploration can be turned to finding the systems responsible for generating the conflict—and away from a preoccupation with the symptoms and efforts immediately associated with the conflict.

Despite the demonstrated effectiveness of various approaches to psychotherapy there is still no generally accepted account of how these effects are achieved. In fact, it has been shown (e.g. by Wampold 2001) that psychotherapies based on quite different models of disorder can have similar effects. As a consequence, there has been an increasing call to move away from developing new techniques and strategies based on diagnosis and instead to focus on underlying common principles and mechanisms (e.g., Rosen & Davison, 2003).

The paradigm of perceptual control provides a common underlying process (conflict) and a common change mechanism (reorganization) that may provide the means to make sense of these otherwise puzzling results.

While some of the propositions about the application of PCT principles to psychotherapy remain speculative, there is also indirect but strong evidence for this approach. Problems of control (understood as control of behavior, impulses, emotions, or thoughts) are widely recognized as important in psychological functioning. Many approaches to psychotherapy use conflict formulations to explain psychological distress (Carey 2008, 2011). Many approaches also depend upon awareness in resolving problems and recognize the need to consider problems from higher levels of thinking (such as important life values or belief systems). Also consistent with the nature of reorganization is a growing body of literature that recognizes that the change involved in the resolution of psychological distress is not a linear or predictable process (e.g. Hayes 2007).

Exploring psychological disorders and their treatment from the perspective of perceptual control provides a new direction for psychotherapy researchers and practitioners. An understanding of the nature of psychological distress that is developed from a model of normal function rather than dysfunction will help to clarify the purpose and process of treatment. By distilling the important components of psychotherapy, it allows therapists to be clearer about their roles and to make their treatments more efficient, and it can provide insight into the purpose of psychotherapy. PCT, then, will have an impact on long standing debates such as the equal effectiveness of treatments versus the superiority of some treatments or the importance of specific versus common factors. PCT proposes a consistent and coherent approach that could provide a unifying focus for dealing with distress. With a unifying focus, a more consistent and coherent approach can emerge that will go a long way towards preventing the debilitating impact of psychological distress that is currently on the increase in many countries.

A guide for learning MOL therapy is provided by Carey (2006). Applying the Method of Levels does not assume blind faith in the correctness of PCT. Rather, every application is an opportunity to challenge and test the theory, as well as a chance to put

9 "Background thoughts" are probably the same phenomenon described by Beck (1976) as "automatic thoughts."

the theory to good use. Research into MOL therapy has been started in several countries—see Bird, Mansell, and Tai (2009), Carey (in press), Goldstein and Goldstein (2005), Goldstein (2007). This research must be continued and extended in order to evaluate the theoretical expectations which are based on the concepts of negative feedback control, reorganization, redirection of awareness to higher perceptual levels, and internal conflict resolution.

Afterword

The reader of this paper may be experiencing some internal conflicts between implications of PCT and some other theory that has seemed reasonable and believable. We can only comment (not very helpfully) that most of the people now engaged in the exploration of PCT were trained in some other way of explaining and understanding the behavior of humans and other organisms. Most have used and even taught those other ideas for many years. Each person has had to work through the internal and professional conflicts involved in a sometimes wrenching change of understanding. It may be a little helpful to keep in mind that such conflicts are to be expected, and that persistence will probably resolve them. PCT suggests that this conflict is at the highest levels, principles and systems. Control of perceptions at these levels is the hardest to change, we assume because every high-level change requires many lower-level changes, the need for which may take time to become apparent.

Resources

Computer simulations

The two sets of demonstration programs referenced in this paper are available at:

- www.livingcontrolsystems.com/lcs3.html.
- www.livingcontrolsystems.com/PCTDemo3.html

Earlier DOS and Windows programs by Powers can be downloaded from:

- www.livingcontrolsystems.com/demos/tutor_pct.html

Programs by R. Marken can be run in a web browser:

- www.mindreadings.com/demos.htm

Reference websites

Introductions and discussions of Perceptual Control Theory can be found at several web sites. Four of the most comprehensive reference sites are:

- www.iapct.org/
- www.livingcontrolsystems.com
- www.pctweb.org/
- www.mindreadings.com/

References

Ashby, W. Ross. 1952. *Design for a brain*. London: Chapman & Hall.

Bandura, A., Grusec, J. E., & Menlove, F. L. (1966). Observational learning as a function of symbolization and incentive Set. *Child Development*, 37, 499-506.

Beck, A. T. (1976). Cognitive Therapy and the Emotional Disorders. New York: New American Library.

Bernstein, N. (1967).*Coordination and regulation of movements*. New York: Pergamon Press.

Bird, T., Mansell, W., & Tai, S. J. (2009). Method of Levels: initial steps in assessing adherence and the development of a qualitative framework for mapping clients' control hierarchies. *The Cognitive Behaviour Therapist*, 2, 145-166.

Black, H. S. (1934). Stabilized feed-back amplifiers. *Electrical Engineering*, 53, 114-120.

Black, H. S. (1977). "Inventing the negative feedback amplifier", *IEEE Spectrum* 14, 54-60.

Burke, P. 4 October 2007. *Identity Control Theory.* http://wat2146.ucr.edu/Papers/05d.pdf

Campbell, Donald T. (1988). A general 'selection theory' as implemented in biological evolution and in social belief-transmission-with-modification in science [A commentary on Hull]. *Biology and Philosophy*, 3, 171-177.

Carey, T. A. (2008). Conflict, as the Achilles heel of perceptual control, offers a unifying approach to the formulation of psychological problems. *Counselling Psychology Review*, 23, 5-16.

Carey, T. A. (2011). Exposure and reorganization: The what and how of effective psychotherapy. *Clinical Psychology Review* DOI 10.1016/j.cpr.2010.04.004

Carey, T. A. (2006). *The Method Of Levels: How To Do Psychotherapy Without Getting In The Way*. Hayward, CA: Living Control Systems Publishing.

Carver, C.S. & Scheier, M.F. (1998). *On the self-regulation of behavior.* Cambridge, United Kingdom: Cambridge University Press.

Collier, G., Johnson, D., Hill, W.., and Kaufman, L. (1986) The economics of the law of effect. *Journal of the experimental analysis of behavior*, 46, 113-136.

Goldstein, D.M., & Goldstein, S.E.(2005). *Q Methodology study of a person in individual therapy.* Clinical Case Studies, 4, 40-56.

Goldstein, D.M. (2007). Method of Levels Therapy: Helping the normal change process within a person when normal change doesn't seem to be happening by itself. *The International Journal of Healing and Caring,* 7, 1.

Hayes, A. M., Laurenceau, J. -P., Feldman, G., Strauss, J. L., & Cardaciotto, L. A. (2007). Change is not always linear: The study of nonlinear and discontinuous patterns of change in psychotherapy. *Clinical Psychology Review, 27,* 715–723.

Hebb, D. O. *The Organisation of Behavior: A Neuropsychology Theory.* New York: Wiley & Sons.

Kennaway, J. R. (1997). Unpublished Note. "Population statistics cannot be used for reliable individual prediction" www2.cmp.uea.ac.uk/~jrk/distribution/correlationinfo.pdf.

Lashley, K. S. (1960). The problem of serial order in behavior. In: F.A. Beach, D.O. Hebb, C.T. Morgan and H.W. Nissen, Editors, *The Neuropsychology of Lashley*, McGraw-Hill, New York.

Mansell, W. (2005). Control theory and psychopathology: An integrative approach. P*sychology and Psychotherapy: Theory, Research and Practice, 78*, 141-178.

Marken, R. S. (1988). The nature of behavior: Control as fact and theory. *Behavioral Science*, 33, 196-206.

Marken, R. S. (2001). Controlled variables: Psychology as the center fielder views it, *American Journal of Psychology*, 114, 259-282.

Marken, R. S. (2002). Looking at behavior through control theory glasses. *Review of General Psychology*, 6, 260–270.

Editors, McClelland, K.A., & Fararo, T.J. (2006). *Purpose, meaning and action.* New York: Palgrave Macmillan.

Miller, GA, E. Galanter, & K.A. Pribram. 1960. *Plans and the structure of behavior*. New York: Holt, Rinehart, & Winston.

Powers. W.T., Clark, R.K., and McFarland, R.L. (1960). A general feedback theory of human behavior. *Perceptual and Motor Skills* 11, 71-88 (Part 1) and 309-323 (Part 2). [Reprinted in *General Systems V*, 63-83, 1960. Partial reprint in Smith, A. G., *Communication and Culture*, New York: Holt, Rinehart, and Winston (1966).]

Powers, William T. (1973). *Behavior: The Control of Perception*. 1st ed. Hawthorne, NY: Aldine de Gruyter.

Powers, William T. 1992. *Living Control Systems II*. New Caanan, CT: Benchmark Publications. [Selected papers 1988-1992.]

Powers, William T. 1998. *Making Sense of Behavior*. New Caanan, CT: Benchmark Publications.

Powers, William T. (2005). *Behavior: The Control of Perception*. 2nd expanded ed. New Canaan: Benchmark.

Powers, William T. (2008). *Living Control Systems III: The Fact of Control.* New Canaan, CT: Benchmark Publications. [Includes a CD with a set of demonstration programs.]

Rescorla, R. (1988); Pavlovian Conditioning: it's not what you think it is. *American Psychologist, 43,* 151-160.

Richard, P. B. (1983). Mechanisms and adaptation in the constructive behaviour of the beaver (*C.fiber L.*). *Acta Zool. Fennica*, 174, 105–108.

Riggs, D. S. (1976). *Control Theory and Physiological Feedback Mechanisms.* Huntington, NY: Reobert E. Krieger Publishing Company.

Robertson, R. J., Goldstein, D. M., Marmel, M., & Musgrave, M. (1999). Testing the self as a control system: Theoretical and methodological issues. *International Journal of Human-Computer Studies, 50,* 571-580.

Rodgers, J.L. (2010). The Epistemology of mathematical and statistical modeling. *American Psychologist, 65, 1-12.*

Rosen, G. M., & Davison, G. C. (2003). Psychology should list empirically supported principles of change (ESPs) and not credential trademarked therapies or other treatment packages. *Behavior Modification, 27,* 300–312.

Runkel, P. J. (1990/2007). *Casting Nets and Testing Specimens: Two Grand Methods of Psychology*. New York: Praeger; Hayward, CA: Living Control Systems Publishing.

Schwartz, J.M. (1996). *Brain lock*. New York, NY: HarperCollins Publishers.

Skinner, B. F. (1969). *Contingencies of reinforcement: A theoretical analysis.* New York: Apple Century Crofts.

Skinner, E.A. (1996). A guide to constructs of control. *Journal of Personality and Social Psychology*, 71, 549-570.

Thorndike, E. L. (1927). The law of effect. *American Journal of Psychology, 39,* 212-222.

Vallacher, R. R. & D. M. Wegner. 1985. *A theory of action identification*. Hillsdale, NJ: Lawrence Erlbaum Associates.

van de Rijt, H., & Plooij, F.. (2010). *The Wonder Weeks. How to stimulate your baby's mental development and help him turn his 10 predictable, great, fussy phases into magical leaps forward*. Arnhem, The Netherlands: Kiddy World Promotions B.V. [First published in 1992 as Oei, ik groei! by Zomer & Keuning Boeken B.V., Ede and Antwerp. Updated with interactive participation of researcher-parents.]

Wampold, B.E. (2001). *The great psychotherapy debate: Models, methods, and findings.* Mahwah, NJ: Lawrence Erlbaum.

Wiener, N.: (1948) *Cybernetics or control and communication in the animal and the machine*. Cambridge, MA: MIT Press.

Email discussing this document:

Date: Fri, 03 Jun 2011
From: Bill Powers
Subject: Re: Perspectives on Psychological Science - Decision on Manuscript ID PPS-11-099

Hello, Bruce --

On 6/3/2011, Bruce Nevin wrote (to Rick):

BN: No one has responded to your plea for help with our jointly produced "paradigm" paper. I say again that the key is audience. Bill said, and we agreed, that we were writing it for a general audience of intelligent readers of technical bent. We have not submitted it to a journal that has that readership. Instead, we have submitted it to journals addressed to a particular audience of intelligent readers with prior commitments in psychological theory. As I understand it (maybe wrongly), you offered to rewrite it for that audience. I am not surprised that this has been a discouraging task. It is much too frank a survey to get past their defenses. And it is a survey, rather than a report of previously unpublished work. Of course, the survey covers ground that is new to those readers, but editors of those psych journals assume that for something to be relevant for their readers it must naturally be on familiar ground and that therefore to be newsworthy it must be new, i.e. recent and not previously published results.

BP: I think you've made this problem very clear. I have started planning to talk at the CSG meeting in July, or at least organize a discussion, about a direct confrontation with conventional ideas, perhaps through a book to be written via Google Docs by all of us who are concerned. I wish everyone on this CC list would come to the meeting, but not all can.

When I first started writing *Making Sense of Behavior*, the title was *Starting Over*. Those who heard about that were very reluctant—that would be a little like burning bridges instead of building them. But aside from the personal contacts we make, or the writing of popular (non-scientific) works, it's starting to look as though there isn't any other choice. The bridge keeps getting burned by the people on the other side. They don't realize that we're trying to rescue them before that little island they're on is washed away by the tsunami.

So I say, let's make waves.

Best, Bill