

# **Radical Constructivism and PCT**

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Radical constructivism has been linked with Perceptual Control Theory since Ernst von Glasersfeld and I met thirty-odd years ago. During all that time I'm sure we both have thought we were on parallel paths but with different objectives: the paths might meet at infinity, but for the time being were separate.

Now I think I see a kind of convergence that could be achieved having to do with the age-old problem of dualism. I hasten to add that I am not a philosopher but a physicist and engineer, so may not use this unfamiliar terminology correctly. Please make allowances. I will describe my idea in as neutral a language as I can, and leave it to real constructivists to perform the required translations.

First, for those not acquainted with my work, a brief summary of PCT.

### **Perceptual Control Theory**

PCT is based on classical control theory, which is the mathematical treatment of systems in which the outputs continually act on the inputs to keep them in states specified by reference signals inside the behaving system. Cyberneticists are familiar with these systems, though perhaps not as familiar as I would like them to be. The model I have been working on for some 55 years uses a hierarchical form of control, in which higher-order systems act not by telling lower systems what outputs to produce, but what inputs to provide for themselves by using still-lower systems in the same way. Only the lowest order of control systems generates outputs that affect the environment, thus altering the inputs to those first-order systems and consequently the inputs to all higher orders. In control engineering, this sort of arrangement is called a "cascade" of control systems. In PCT we simply call it "the hierarchy." This is not a social hierarchy like those loathed by Heinz von Foerster, but a way of designing complex control systems that are both simple and modular. See the end-notes for internet access to background materials.

### **Levels of organization**

In the PCT model, 11 levels of organization have been proposed so far, each concerned with controlling a specific class of input or perceptual signal. Without elaboration, the levels as currently imagined, from bottom to top, are said to control perceptions of intensities, sensations, configurations, transitions, events, relationships, categories, sequences, programs, principles and system concepts -- confidence diminishing with each increase of level. Perceptions of a given level are functions of perceptions at one or

more lower levels, and control of perceptions of a given level is achieved by specifying reference conditions for some set of control systems of lower level.

Note that the term "perception" is used here in a generic way, applying to any afferent signal in the nervous system at any stage of processing after the initial sensory event. Perceptions are "constructed" at every level, even the first: the magnitude of a raw sensory signal depends on many local physical variables, being a function of them but not a representation of any one of them. In general, every level of perception is a neurally constructed function of multiple perceptions at lower levels. The relationship of these perceptions to entities in the world outside, if any, is probably not knowable. As von Glasersfeld has remarked, the brain is not the black box; the environment is.

The principle of hierarchical control is more important than the particular identifications of levels of control, which is a subject for experimental investigation. The levels were proposed to show how a fairly complete model might be constructed to encompass all aspects of human behavior and experience from the most concrete to the most abstract, and how the abstract aspects of experience might be controllable through the use of progressively less-abstract control processes. PCT provides a continuous path from thought to action, and explains goal-seeking at many different levels at the same time. Whether it does so correctly has yet to be determined.

### **Reorganization: PCT's theory of learning**

The other main division of PCT is reorganization theory, which replaces the concept of reinforcement introduced by Thorndike and elaborated by Skinner.

Reinforcement theory says that when a response in the presence of some set of stimuli produces a consequence beneficial to the organism, the probability of generating that same behavior is increased; this process, repeated, eventually brings that behavior under stimulus control, as radical behaviorists put it.

Reorganization theory is essentially the mirror image of reinforcement theory. Under reorganization theory, the assumption is that changes of brain organization begin to occur when there is a lack of something that behaviorists would call a reinforcer: food, water, warmth, comfort, and so on. When a behavioral organization is found that tends to supply what is lacking (or remove what is not beneficial), the rate of change of organization is slowed. The result is that when the lack (or excess) is essentially erased, reorganization will cease, leaving a new organization of behavior in place. This is essentially the same as W. Ross Ashby's (1953) idea of "superstability." It was adopted in the first paper introducing the ideas that led to PCT (Powers, Clark, & Macfarland

1960), although at that time it seemed a bit far-fetched since there was no known algorithm by which reorganization could work efficiently enough to be of use during a single lifetime. Twenty years later a successful algorithm was found in a book on the gradient-climbing behavior of *E. coli*, and became part of the array of PCT's demonstrations of principle.

### **The Method of Levels**

As PCT was developed in the 1950s and 1960s, some tentative applications were envisioned, including a novel (though not totally original) approach to psychotherapy. This is the branch that is of interest here, because it deals with the relationship of consciousness or awareness to the operation of this quite mechanistic naive-realist model. This bears on what we mean when we speak of the observer and the observed. The concept of levels of perception is integral to the method of levels, and also, I will propose without much further ado, to the question of dualism.

At the core of the method of levels, or MOL, is a phenomenon of awareness. It is possible, while thinking about and discussing some topic, to have thoughts occurring in the background not about that topic but about the thoughts and the discussion, such as "I'm not explaining this very well." It occurred to me and a friend, long ago, that this foreground-background phenomenon might have something to do with levels of control or at least levels of perception. Kirk Sattley and I proceeded to explore this phenomenon, taking turns with one introspecting and the other listening and questioning, to see if there was more than one level involved. There was. But the most interesting side-effect was that when pursued for as many levels as could be found, the result was a most peaceful state of mind and an apparent dissociation from the operation of the hierarchy. I think that is the state that has been called, in more recent years, "mindful awareness."

This may be sufficient for some readers to jump ahead to ideas about the observer and the observed, but I shall plod on. One of the properties of awareness that appears quickly during an MOL session is its mobility. The content of awareness changes rather quickly and easily from one topic to another, and also from one level of perception to another (from the abstract to the concrete and back). And as the objects of awareness change, it becomes quite obvious that one's emotional state and viewpoint also change, sometimes radically and dramatically. It's not just that one attends to one part of the perceptual world or another; it seems also that one occupies or identifies with one part of the brain's hierarchy or another, from which to view each new set of perceptions. The process of exploring further and further into the background thoughts has been likened to walking up a staircase backwards. One can see where one has been, but not where one is going.

And to see the step now being occupied, it is necessary to move one step higher and observe the place just vacated.

While there is a definite lack of scientific rigor in these images, behind them are some quite definite and reproducible observations. We now get a picture of multiple levels of perception and control, with this unexplained phenomenon called awareness moving, like a ghost in the machine, from one position to another, horizontally or vertically. And during this process, the person doing the inner explorations encounters, from time to time, attitudes and feelings that form what we commonly call a Self.

One of my colleagues who went through these explorations found (with the aid of a Q-sort and a factor analysis) that inside him was a youthful brash graduate student, a nurturing mother, and a macho, tough-guy father, each one seeing the world in a different way and having different kinds of goals. The MOL style of exploration led to a peculiar sort of experience in which this person was telling me about these different selves and their characteristics, without apparently being any one of them.

We have suddenly arrived at the point of this essay. During this exploration, it was clear that there was an Observer Self who merely observed and reported on each of the other Selves and their relationship to the world and other people. With regard to those other selves, dualism is clearly evident. A particular self being Observed is the observer, the perceptual signals representing everything else are the observed. And somewhere in the background is the "real" Observer Self, watching the other self and the world it is interacting with, but totally unaware of its own point of view. The true Observer Self can be aware of everything else, but not of itself.

That conclusion is partly experiential and partly a result of observing someone else doing this sort of exploration. It seems that the world of the Observer Self is monistic, for there is only the Observed to be aware of. But among the objects of observation is a different sort of self that can be observed, reported on, and described -- and that sort of self is in a dualistic relationship to its world: the observer can be seen clearly as something distinct from the observed -- but only because the true Observer Self can see both.

In PCT, we have developed many working computer models to demonstrate principles and underlying relationships (Powers, 2008). These models propose a hierarchy of control inside an organism, interacting with an environment that is described by the models normally used in the physical sciences. So the models, like most models in the physical sciences, are purely dualistic: there is an active system sensing and acting upon an environment that is distinct from the system. In the background, however, there is

always another kind of system, one that thinks about the model and its environment, that adjusts and test the model, that tries to make the model as much like real people as possible -- without being clear about just who or what is doing all this. Somewhere in that background there is the real Observer Self, about which it is difficult to say anything at all.

What these ideas seem to suggest is that monism and dualism are not as different as they may seem. The idea of levels of perception and control might suggest that it is possible for both to be a correct description at the same time. And that is about as far as a mere engineer can carry this.

Radical constructivism has been criticized because of supposed overtones of solipsism, but PCT shows clearly how the world of experience could be constructed and even controlled by the brain, without in any way implying that there is no external reality. In fact PCT models strongly suggest an objective reality, because control systems control the perceived world by acting through the unperceived external world: it is necessary to find out how actions really affect perceptions (however they are constructed) in order to achieve control. We learn those effects through interactions with whatever lies beyond the senses, though the problem of understanding just how those effects are brought about, Out There, remains intractable.