

Mary on PCT

Post to the Control Systems Group Network, Nov 11, 1992

From: Mary Powers

... I am getting requests for information about CSG from netters and by snail mail. The following is what I am sending out...

While the existence of control mechanisms and processes (such as feedback) in living systems is generally recognized, the implications of control organization go far beyond what is generally accepted. We believe that a fundamental characteristic of organisms is their ability to control; that they are, in fact, living control systems. To distinguish this approach from others using some version of control theory but forcing it to fit conventional approaches, we call ours Perceptual Control Theory, or PCT.

PCT requires a major shift in thinking from the traditional approach: that what is controlled is not behavior, but perception. Modeling behavior as a dependent variable, as a response to stimuli, provides no explanation for the phenomenon of achieving consistent ends through varying means, and requires an extensive use of statistics to achieve modest (to the point of meaningless) correlations. Attempts to model behavior as planned and computed output can be demonstrated to require levels of precise calculation that are unobtainable in a physical system, and impossible in a real environment that is changing from one moment to the next. The PCT model views behavior as the means by which a perceived state of affairs is brought to and maintained at a reference state. This approach provides a physically plausible explanation for the consistency of outcomes and the variability of means.

The PCT model has been used to simulate phenomena as diverse as bacterial chemotaxis, tracking a target, and behavior in crowds. In its elaborated form, a hierarchy of perceptual control systems (HPCT), it has lent itself to a computer simulation of tracking, including learning to track, and to new approaches to education, management, and psychotherapy.

Control systems are not new in the life sciences. However, numerous misapprehensions exist, passed down from what was learned about control theory by non-engineers 40 or 50 years ago without further reference to newer developments or correction of initial misunderstandings. References in the literature to the desirability of positive feedback and the assertion that systems with feedback are slower than S-R systems are simply false, and concerns about stability are unfounded.

The primary barrier to the adoption of PCT concepts is the belief—or hope—that control theory can simply be absorbed into the mainstream life sciences without disturbing the status quo. It is very hard to believe that one's training and life work, and that of one's mentors, and their mentors, must be fundamentally revised. Therefore, PCT appeals to those who feel some dissatisfaction with the status quo, or who are attracted to the idea of a generative model with broad application throughout the life sciences (plus AI and robotics). There are very few people working in PCT research. Much of its promise is still simply promise, and it meets resistance from all sides. It is frustrating but also tremendously exciting to be a part of the group who believe that they are participating in the birth of a true science of life.