

## Chapter 22

# More about the control loop

This chapter contains a couple of topics that will amplify what I have already said about the control loop. You may already have figured out some of these implications for yourself.

### UNINTENDED AND IRRELEVANT EFFECTS

All behavior is undertaken to control some perceptual variable, one or more. But an act on the environment can have effects on many perceivable variables, among which only a few are those the person intended, perhaps only one. We can call the unintended effects “side-effects.” Some of those side-effects impinge on variables the person is controlling, some do not.

Let us imagine that I sit down at the piano on a balmy spring day and play the Intermezzo No. 1 of Brahms’s Opus 117. I want to control those luscious sounds that my fingers strike from the singing strings. There will be, however, various side-effects. My wife stops preparing lunch and listens to the music. Those two side-effects are relevant for me, because I care about both. I want to have lunch before long, and I also want to know that my wife, too, enjoys the music.

So far, I have illustrated unintended side-effects on variables controlled by the actor. In my example, am unaware that have done anything to delay lunch. (My lunch-time is properly called a controlled variable, because, if I knew that I was delaying my lunch, I would do something to shorten the delay. Similarly, I would be happy to learn that nothing is altering my wife’s enjoyment of Brahms’s music—not even my playing of it.) In what I say below, I will use the word “relevant” as a short way to say “relevant to what I care about,” which, in turn, is short for “relevant for my control of

variables that I want to control.” Now I return to the example of my imaginary piano playing.

Some side-effects impinge on variables uncontrolled by the actor. I had such effects particularly in mind when I drew the box labeled “Events irrelevant to the person” in Figure 4-1. Suppose a neighbor, no admirer of Brahms, closes her window. Suppose that I am not aware that she does so, and that I do not become aware later, because she never tells me she did that. That is an example. Or a bird might fly by, be distracted by the musical sounds, circle a few times before resuming her hunt for juicy insects, and thereby fail to encounter a male of her species who would have helped her pass on her music-loving genes.

An act, then, can produce

- 1 an intended effect on a variable controlled by the actor,
- 2 unintended side-effects on variables controlled by the actor, and
- 3 unintended side-effects on variables uncontrolled by the actor (“irrelevant events”).

Onlookers may or may not care about any of those effects; that is, the actor’s action, intended or not, may or may not impinge upon a variable being controlled by someone else.

Here are a few examples. Perhaps I put fertilizer on my lawn. The variables I care about are the green color and how close together the blades grow. If the turf is bright green and closely packed, I am happy. But my action has other effects, too. The fertilizer is poison to most of the small creatures living in the soil. They mostly die off, and the nourishment in the soil declines. I find that I have to use more fertilizer to get the same results. In addition, a good part of the fertilizer runs off the top of the soil, into the city’s storm sewers, and eventually into the river. There it poisons fish and other aquatic creatures. It also increases the

shaped us to protect ourselves more carefully during the years before we have passed on our genes to our offspring. I don't think adolescents are more cautious than older people; insurance companies tell us they kill themselves in automobiles at a higher rate than older people do.

The survival of the species, too, may not be built into the neural hierarchy, but may instead be a side-effect of inherited urges such as sexual attraction. If survival itself were somehow built into genes, we would expect the specification to have included some way to avoid killing off the species through overpopulation or atomic warfare. Be that as it may, we can hardly expect evolution to prepare us by natural selection for dangers that have never happened (to our species) such as atomic winter, excessive rise of global temperature, collisions with large meteors, or galactic catastrophes. In such matters, cockroaches and bacteria seem to have the advantage over us.

### **CONTROL SYSTEMS FIND THE ONLY POSSIBLE ACTION**

You have no doubt noticed by now that adherents of PCT are proud that PCT goes a long way to explain how it is that among the dozens or even thousands of actions that seem available for getting to a goal, somehow an organism can find the act that turns out to be just the act that will do it. Dag Forssell, at this point, reminded me that a bird darting through the air toward a tiny entrance to its nest will flex its wings on final approach so it dives in just right every time, regardless of the direction of its approach or the wind at that moment. Among all the tensions of muscles in a human arm that can bring a glass toward the mouth, most drinkers activate just the right combination of tensions that succeed in lifting the glass to the mouth. It is true that now and then we stumble, spill the milk, or mistake one person for another. We also, however, achieve our goals well enough to grow up, get formal educations, attract mates, raise families, and stay alive for enough years to make sellers of annuities and health insurance lugubrious. In Chapter 14, I described how very reliably we walk and drive automobiles.

The only way in which a consistent result (consequence) can be maintained in a varying environment is by compensating for that variation with suitable actions. A tennis game is a dramatic exhibition of

the principle of achieving a repeated result by varying means. If you take getting the ball back over the net and within bounds as at least one of the tennis player's goals every time he returns the ball, then every whack at the ball is an exhibition of one more way to achieve that goal. And that way of doing it at that whack has to be *just right*. Sometimes a return seems fairly easy, but sometimes the player obviously has to strain every sinew to get to just the right place, bring the arm into just the right swing, and hit the ball with just the right angle and force that will compensate for the angle and force and spin that the other player has put on the ball. If any small part of that complicated series of movements is not quite right, the ball is missed or goes out of bounds.

In a communication to the CSGnet on 26 June 1995, Powers put it this way:

What we commonly call behavior is really a resultant; the outcome of combining forces created by an organism with forces that originate elsewhere.

When we see it this way, we realize how strange it is that an organism can actually appear to emit the same physical consequence of action over and over. . . . In any one physical situation, there is only ONE action the organism can take that will have a particular physical effect. If the local environment changes in any way, there is still only ONE action the organism can take to create the same effect as before, but now it is a DIFFERENT action.

. . . when the organism emits a particular physical effect, its action is PRECISELY THE ONLY ACTION THAT COULD HAVE PRODUCED THAT EFFECT AT THAT TIME.

When the tennis player returns the ball to the left toe of the other player, the player does everything to compensate for the force and angle and spin with which the other player sent the ball to the player, for the wind direction and force, for the fatigue in the player's own muscles, and for everything else that could have an effect on the ball, in precisely the only action that can produce that effect at that time.

We often say rather loosely that many actions can produce the same effect. That is true over a series of acts when we are speaking loosely of the "same" or repeated effect. At one volley, the tennis player returns the ball by one combination of running and whacking, and at another volley achieves the "same" result by another combination of running and whacking.