

Chapter 9

Some social interaction

In Chapter 7, I told about some laboratory studies demonstrating some of the key features of PCT; namely, (1) You cannot be sure what a person is “doing” by watching the person act. Actions are steps along a path to a goal. Even when you successfully divine one of another person’s goals (or your own), there are always further goals lurking unseen. (2) Living creatures can make their way toward a goal effectively even when using very simple and primitive ways of finding a path. *Escherichia coli* can “steer” only by random flip-flops, but nevertheless finds food enough. (3) When a variable changes the way you would expect the external physical world to cause it to change, you can conclude that no living thing is keeping it from changing. That is the essence of The Test for the Controlled Quantity—which, in turn, is the basis for experimental method in PCT. (4) Control is effected at many “levels.” The Test applies to maintaining such a complex “variable” as self-concept as well as to such a simple, “sensory” quantity as distance between marks on a computer screen. In Chapter 7, I described The Test in some detail.

In Chapter 8, I described three examples of model-making. In this chapter, I will describe, first, a use of PCT in studying stages of development in infancy. This study illustrates further the use of The Test. It also gives some corroboration of Powers’s proposed levels in the neural hierarchy. Then I will describe a simulation of movements in a crowd, and after that a simulation of the collective control of perceptions. These simulations are not models of unique single individuals, but rest on models of hypothetical individuals.

DEVELOPMENTAL STAGES IN INFANCY

It is characteristic of almost all living creatures that they change as they age. The common term for this change is “development.” Some of the changes occur in all the individuals of a species. Examples in humans are growth in size, maturation of the sexual organs, babbling, walking, and speaking words. (When I say “all individuals,” I mean all genetically normal individuals who encounter the necessary environmental opportunities.) Specific changes occur within certain time periods. When individuals do not find the necessary environmental matrix for the changes at the right ages, abnormal and pathological developments occur. Some changes that occur as we grow older do not expand our capabilities, but instead reduce them. Instead of calling those changes development, we often call them degeneration.

Other changes occur in some individuals but not in others. I speak here of changes in the sense of types of capabilities that the individual could not have exhibited earlier. In this sense, changes can be called development even though they occur only in some individuals. We speak of “developing” a skill such as using a carpenter’s saw. Not all humans develop the skill of sawing. It is obvious, nevertheless, that genetic endowment has something to do with sawing: at a very early age, the human cannot even recognize the saw as a “thing.” At a later age, the human can perceive the “thingness,” but is too small and weak to pick up the saw. At a still later age, the human can pick up the saw and even place it against the wood, but the idea of purposefully moving it back and forth may be beyond his imagination. And so on. The creature’s genetic endowment makes sawing eventually possible, but does not cause it to happen, to be tried, or even to be imagined. We grow into a bodily structure that enables us to climb trees, but if

we grow up where there are no trees, we do not engage in tree-climbing motions.

A great many of the opportunities for action that we encounter are provided by our culture. Our culture (in the U.S.A.) makes it easier for us to get food by buying it at a grocery store than by throwing a spear at a wildebeeste. Our culture makes it easier (for most of us) to satisfy sexual desires by becoming acquainted with possible sexual partners in customary social activities, using language to test possible intentions, and so on, instead of—but what can I write here? My imagination fails when I try to imagine how sexual behavior could go if there were no cultural paths provided for it. What I want to say in this paragraph is that some of our behavior is strongly specified by genetic requirements (urinating every day, for example) and some of it is not specified at all by genetic requirements (where we urinate, for example). But I think it is a bootless question whether a given action partakes more of heredity or environment. I wrote about that futility in Chapter 3 under “Person and Environment.”

There is the old joke about the English couple who adopted a baby born to French parents; the couple enrolled in a course in conversational French so that they would be able to understand the child when it began to speak. Our genes do not require us to speak French, but they do seem to require us to speak. Do our genes require us to live in groups? In families? To produce children? Once a child has reached the stage of babbling, is language then entirely learned, or do our genes specify some of the structure of language? The arguments about nature versus nurture seem to go on forever. But not here.

The Neural Hierarchy

Investigators of the functioning of humans and other animals often want to distinguish capabilities that are necessarily developed by the maturing organism from those that are merely enabled or permitted, but not required, by maturation. Since PCT conceives behavior as the varying means of controlling perceived quantities, the developing capabilities of the organism are conceived in PCT as developing capabilities of *perception*. PCT conceives the levels of the neural hierarchy, accordingly, as successive levels of perceptual capability or of the inclusiveness of control of perception. One can describe the hierarchy as one of successively more encompassing control systems—control systems that control a col-

lection of lower control systems. Earlier, I gave a few examples; one was the experiment by Marken (1986) in Chapter 8 under the heading “Hierarchy.”

The key to thinking about the levels of the hierarchy is that upper levels control the control (the internal standards) at lower levels, but not vice versa. If you want to walk to the library, your purpose of getting to the library controls the way you make use of your ability to walk, but your ability to control your walking muscles will not necessarily steer you to the library. As long as you maintain your purpose of getting to the library, your walking will take you in that direction, but your walking control is not built to take you only to the library. That is, your internal standard for seeing yourself at the library is at a “higher” level than your internal standard for perceiving yourself walking. I will give here a very quick sketch of the “lower” part of Powers’s postulated neural hierarchy. You will find much more detail and a view of the entire structure in Part IV.

The “lowest” kind of system in the hierarchy is the kind that is in direct contact with external energies—the system such as the one diagrammed in Figure 4–1 of Chapter 4, showing a sensor in the organism and action in the environment. The perception at this lowest level is the electrical excitation in the afferent neural bundle going from the sensor to the comparator and is a perception only of *intensity*. It is not a perception of light, or warmth, or sound, or pressure, but of mere intensity—of rate of neural pulsing. At this level, there is no distinction among sensory organs. Plooj and van de Rijt-Plooj (1990) report that newborn chimpanzees react with the same sort of “staccato” and “uh-grunt” vocalizations to every kind of change of intensity:

These vocalizations are produced in relation to any disturbance, any sudden change in intensity regardless of the . . . physical variable in which the change in intensity occurs, such as a sudden change in light by a . . . shadow moving across the baby or a sudden sound, such as the creaking of a tree branch, sudden thunder, or “breaking wind” by the mother (p. 70).

The second level is that of *sensation*. Systems at this and all higher levels send their outputs not to actions on the external world, but only to the comparators in lower systems. The output of a second-order system always contributes to a reference signal (internal standard) for a first-order system (or several of them). Perceptions at the second level enable us to distin-

guish from one another (and therefore to control separately) sensations such as light, sound, pressure, warmth, muscular effort, balance, and so on. We can also recognize combinations of sensory signals; Powers (1973, p. 108) gives this example of a sensation that can be recognized by cooks and diners:

The “taste” of a steak is recognized as maximum when a whole array of intensity signals is present, including tastes, smells, temperatures, efforts of biting, and even (sizzling) sounds all in just the right proportions.

The third level is that of *configuration*, which is a static arrangement of sensations. We see shapes not so much by seeing a boundary of a thing as by seeing a difference between one visual sensation and another. To say it another way, we know that a thing has a boundary only if we can experience a difference between sensations. If we are in the middle of a large field of wheat, we can be wholly unaware of passing from the U.S. into Canada. If we look at a cloud in the sky, there is not a line drawn around it to tell us where it is; we see a cloud because we can see a patch of white against a field of blue. The edge of a cloud is often tantalizingly vague.

The fourth level is *transition*, which is what we see when a configuration changes. Transition gives us a perception of motion. We get a feeling of motion not only from seeing the scenery go by, but also from the run of a melody, from a sequence of fingertips walking across the skin, and from the changing tensions in our muscles as we swing a foot.

Fifth is *event*—a perception having beginning, middle, and end, but a rather short one having the character of unity, not having parts. Powers (1998, p. 144) gives examples:

... the bounce of a ball, the explosion of a firecracker, the opening of a door, the serve in a tennis game, a fragment of a song, a spoken word.

Powers’s examples are instructive, but we also think of longer events such as a baseball game. It is even possible to conceive events longer than a human lifetime; historians have put dates on the rise and fall of the Roman empire.

Sixth is *relationship*. Our language contains a large number of words that label relationships: Near, behind, bigger, approaching, sweeter, louder, inside, after, away from, beloved, bossed, infiltrated, and so on and on. The sociologists’ conception of *role* names a class of reciprocal social relationship: father-child, physician-patient, teacher-student, employer-employee, and so on.

In Chapter 18, I will tell you about more of the neural hierarchy: the levels of categories, sequences, programs, principles, and system-concepts, and I will give more detail than I have given here. I am telling you here only enough to help myself tell you about the studies of chimpanzee and human infants by Frans X. Plooj and Hedwig van de Rijt-Plooj.

Evidences of Control

How can we know when we are seeing, in everyday life, actions that a person is using to control a particular perception? Plooj and van de Rijt-Plooj (1994, p. 3 ff.) describe three ways. One way to look for control is The Test (for which see Chapter 7). We can look for—guess at—conditions in the environment that the person is causing to stay the same despite events in the environment that would otherwise cause them to change. If, despite the pulls of gravity and centrifugal force as the mother chimpanzee moves this way and that, and despite the displacement of the baby chimpanzee as the mother changes her hold on the baby, if the baby repeatedly moves across the mother’s bosom to the nipple, we can have some confidence in the guess that the baby wants to maintain a position at the nipple. How can the neonate find its way to the nipple? It is possible that the neonate moves toward more warmth, since the nipple is the warmest spot on the mother’s chest.

A second way to look for control and its level in the hierarchy is to look at the speed of an action. Control systems lower in the hierarchy act faster than those higher, since the changes in sensing by the higher systems must wait for the changes sensed by the lower systems. Powers (1973, p. 74) quotes a passage from a report of measurements of human tracking motions; certain muscular movements in the tracking sequence required .07 and .10 of a second. Plooj and van de Rijt-Plooj (1990, p. 69) say that first-order control systems “are very fast—about 0.1 second or less.” They then go on to say,

Furthermore, since control systems oscillate when they become unstable, with higher-order systems oscillating more slowly than lower-order ones, the frequency of oscillation provides information about the order of control involved. For example, “clonus” oscillations result from unstable first-order systems when muscles exert excessive effort. They oscillate at about 10 [cycles per second]. Several types of “tremors,” such as in Parkinsonianism, oscillate at approximately three