Self-demonstration of a Human Control Hierarchy

From *Introduction to Modern Psychology — The Control Theory View*.
Robertson and Powers; 1990. Chapter 2 by Robertson, page 21.

To demonstrate several "nested" control systems in the body, begin at ***First Order***, which is exemplified in the spinal reflex loop. A subject (S) extends his or her arm in front of himself or herself, with instructions to hold it steady, and the experimenter (E) places his or her hand lightly on top of S's. E should make sure that S is not holding his or her arm limp. E then gives a sudden sharp downward push, and S's arm appears to rebound as if on a spring. An electromyograph verifies that this is an active, innervated correction, not simply muscle elasticity. The initial position of S's arm makes no difference, and the initial muscle tensions involved also make no difference. S can be asked to hold his or her arm in a different position, and the control action will be the same, showing that the reference signal for the system can be altered and the system will continue to correct its action to the new reference setting.

Second-Order Systems derive their feedback signals from sets of first-order feedback signals. We call this level of control, or second-order feedback (f-2), "elementary sensations," since it represents the initial grouping of first-order (f-1) signals into elements with characteristic sensory patterns. In the kinesthetic modality, there would be signals representing muscle stretch, joint angle, tendon tension, and internal tissue pressure—which add up to the elementary sensations of effort, as when you clench your fist. To demonstrate this order, E now instructs S to extend his or her hand as before and E again places his or her hand on top. Now E tells S to swing his or her arm downward as rapidly as possible, as soon as he or she feels E's downward push. E's hand must be in contact with S's to make the push as sharp and unexpected as possible. Immediately upon the push, S's first-order systems return his or her arm to its initial position, because they act within the latent period of the second-order feedback signal. The initial correction is nearly completed before the second order resets the reference signal.

Third-Order Control. Third-order variables are named "static configurations." They combine classes of sensation feedback. E instructs S as in the second-order demonstration, but now requesting that the movement be made sideways, again making the initial press in the direction of motion. Now, however, E extends his or her other hand, holding out his or her index finger, instructing S to swing his or her arm over to touch the index finger to E's upon the signal. At the instant of the push, E shifts his or her target finger 4 or 5 inches from its initial position. The first two orders of action remain visible, and at the end of S's rapid swing, a third phase can be seen. S's finger comes nearly to a stop where E's finger *was,* and then shows a much slower corrective movement which is noticeably different from the first two actions. The second-order systems achieve their goal states much more quickly than third-order systems—so quickly that under appropriate circumstances they actually have to wait for the next reference signal from the controlling third-order system.

Fourth-Order Control is the control of transitions between different static configurations. E instructs S to extend an index finger and track E's extended index finger. E then moves his or her own finger in a circle 8 to 12 inches in diameter, gradually speeding up. You can notice S first tracing a jagged path while attempting to match E's position, until he or she experiences the regularity of E's movement—at which point S's action smooths into the appropriate circular pattern; he or she has set the reference level of a fourth-order system. The variables of this level are called transition control variables.

Studying behavior within the control-theory paradigm is a different process from that of traditional psychology. Instead of describing an activity of interest to the experimenter (often arbitrarily chosen) and then creating theoretical explanations independently of explanations in other areas of psychology, we first need to present the control-theory model as a whole. Then we shall be able to examine each level of behavior in relation to the others and use comparable rather than incomparable terminology in studying them. The above demonstration comprises a prelude to this process.