A PCT Primer

by Fred Nickols

Perceptual Control Theory (PCT) is the brainchild of William T. Powers and has been articulated by Powers in several books and publications (see the recommended reading section at the end of this paper). In a nutshell, PCT holds that we act in ways that are meant to get and keep things the way we want them. We do this by operating on the world around us. We compare what we see with what we want and we act so as to close or reduce any discrepancy to an acceptable level. Are we able to do this perfectly at all times? Definitely not. Does doing it at all imply any superhuman power on our part? Of course not. We all are subject to the limits of our knowledge and abilities and we all can be overwhelmed by the circumstances at hand. Our control over the world around us is far from complete or perfect. But the fundamental premise remains: Our behavior reflects our efforts to get and keep what we want. And, for the most part, many of us are quite good at it.

The purpose of this paper is to provide a brief, non-technical explanation of PCT and relate it to everyday experience. So, let's get started with an everyday example: driving to work.

> You're on your way to work. Traffic is no heavier or lighter than usual. The wind is a bit stronger than usual, probably the result of a cold front passing through. So, keeping your car in your lane requires more effort than is usually the case. You feel the wind starting to move your car to the left and you immediately steer back to the right to keep it in its lane. You don't even think about it. The usual events mark your commute: someone cuts in front of you and you have to apply the brakes; heavy traffic in the right-hand and center lanes leads you to move to the leftmost lane for a while; there is the usual amount of speeding up and slowing down; and, without fail, some "tailgater" gets up close behind you and so you change lanes to lose that nuisance. Then comes a surprise. You notice "Road Work Ahead" signs and, predictably, traffic begins slowing down. Glancing at your watch, you note that you're cutting things close. So, rather than take a chance on being late to work you get off at the next exit and take an alternate route to your place of employment. As intended, you arrive at work on time. Not as early as originally intended but still on time.

The preceding example illustrates PCT in action. More technically speaking, it illustrates a *negative feedback control system* at work. And that, according to Powers, is exactly what people are: "Living Control Systems." So, let's look now at the elements of PCT.

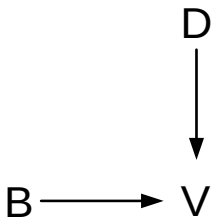

Figure 1

First, there is whatever it is you are trying to control. In the driving-to-work example, there are many such things: the position of your car in its lane, your speed, your route, the distance between you and other cars, your progress, your time of arrival at work and more. Those things you are trying to control are known in PCT as *controlled variables*. We will designate these with the letter V.

Second, there is whatever it is you are doing – your *behavior*. In the example we are using, these include steering the car, speeding up, slowing down, braking, changing lanes, taking this or that exit and so on. We will designate behavior with the letter B.

Third, there are other actors and factors that affect the same things you are trying to control. Gusts of wind can make your car drift. Heavy traffic can slow your progress. Other motorists can cut you off, follow too closely, block your attempts to change lanes or take a particular exit. In PCT the effects of these other actors and factors on the variables you are attempting to control are known as *disturbances* and we will use the letter D to indicate these.

> Two key points need to be made here. First, whatever the current state of a controlled variable might be, its state represents the sum of the effects of your behavior and the effects of any disturbances. Your control over a controlled variable exists because your actions are able to overcome any such disturbances. Second, the kind of control we're talking about here is dynamic, not static; which is to say, for example, that you don't wait until the wind blows your car into another lane to correct for that drift; you start compensating for the wind immediately.

These three elements of PCT – controlled variables, behaviors and disturbances are depicted in Figure 1.

What we've just covered might be thought of as you acting in and on the world "out there." There is also a world "in here" – a world that consists of you, your requirements and your behavior or actions. Let's look now at that other world as shown in Figure 2 on the next page.

First, there are those things that you want, your intended states for the variables you are trying to control. In PCT, your goals, intentions, standards or intended states are called reference conditions. For our purposes, we will refer to them simply as *requirements* and use the letter R to designate them. In the driving-to-work example one such requirement or reference condition might be to obey posted limits and drive at a fairly steady speed of 55 mph or whatever the posted limit might be. You no doubt have other requirements as well: you mean to stay within your lane, not pose a hazard to other drivers or pedestrians (avoid any who pose a hazard to you), get off at a certain exit, make it to work on time; not run out of gas, and so on. There are lots of these requirements or reference conditions at work at any point in time.

Second, there is *perception* (P). The perceptions that matter are yours. In the example of driving to work, these include your perceptions of where your car is in relation to the lane you're trying to stay in;

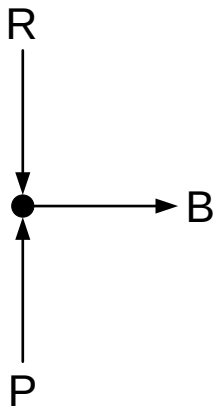

Figure 2

its sideways movement owing to the wind; the distance between your car and those in front of and behind yours; the pace of traffic; any disruptions to the flow of traffic (actual or potential); your speed (probably in relation to posted limits and perhaps in relation to your progress toward your destination); the information revealed by gauges in the dashboard and even the sounds from the road and your car. Your perceptions inform you as to the current state of the variables you are trying to control.

Third is a comparison of P and R. Is there any gap or discrepancy between your requirements and what you perceive? If so, *behavior* (B) occurs. If not, things are going along just fine and no action on your part is required. Remember that higher than normal wind? As it starts to move your car left or right, a discrepancy starts to develop and you immediately compensate by steering in the opposite direction. The same is true for speeding up and slowing down, whether owing to road conditions or other motorists. Lots of adjustments are called for and you make them. And, for the most part, you don't even think about it, you just do it. Remember also the road construction signs? You did have to think about the impact of that potential disturbance and you opted for an alternate route. Why? Because you wanted to get to work on time and the road construction threatened to disrupt your plans. As stated above, the comparison of perceived actual conditions with required or reference conditions will reveal any gap or discrepancy. If an unacceptable gap or discrepancy is detected, you compensate for it; you act in ways that keep the controlled variable (V) at or near the value you have set as a requirement (R).

To recap, your requirements or reference conditions are represented by R. Perceived actual or current conditions are represented by P. The black dot where R and P come together represents the function of comparing the two. If this comparison yields a discrepancy, you behave in ways that serve to reduce or eliminate any such gap. Behavior or actions are represented by the letter B. Your behavior, then, links your world "in here" with the world "out there."

Although we intend to control some variable, all we know of it is known to us through our perceptions. Further, any requirements we have for that variable is internal to or part of us, not part of that variable itself. Our perceptions provide us with feedback about the current state of any variable we seek to control and it is these perceptions of such variables that we compare with our requirements and consequently lead to behavior or not. In other words, what we really control are our perceptions. And that is why PCT is called Perceptual Control Theory.

Combining the two models shown in Figures 1 and 2 yields a third model shown in Figure 3. This model couples the two previous models via the lines entering and leaving Behavior (B) and the dotted line indicating feedback in the form of Perceptions (P) of the variable we are trying to control (V). The model in Figure 3 also uses overlapping circles to identify and distinguish between the person and that person's immediate environment.

Are there other matters we could discuss? Sure; lots of them. For example, we could delve into the difference between positive and negative feedback, why that difference is important in a control system, and the fact that negative feedback is what makes control work. We could explore a much more complex, hierarchical view of the many levels of control systems that govern human behavior, what is known as "hierarchical PCT or HPCT." (Even that seemingly simple, long-ago-mastered driving behavior of ours

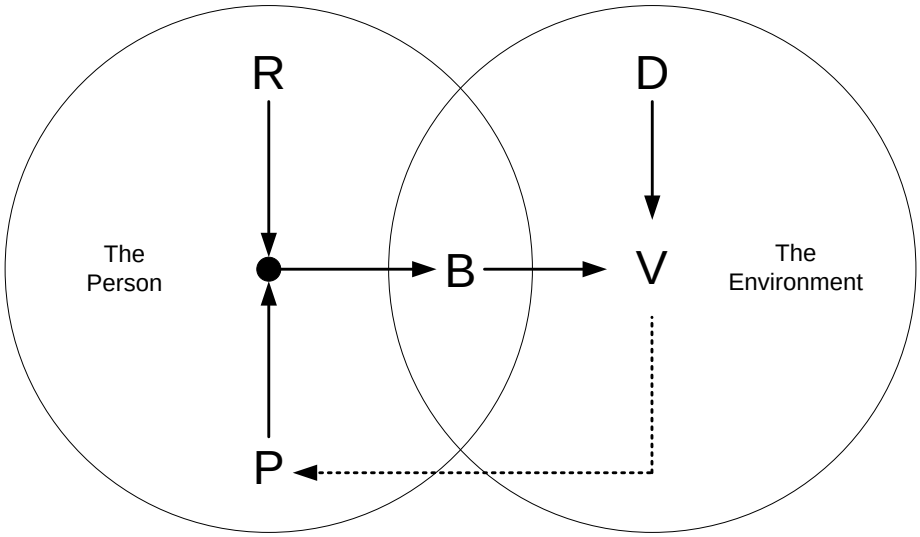

Figure 3

has many layers of complexity; for example, intensities, sensations, configurations, transitions, sequences, relationships, categories, events, programs, principles and systems concepts.) We could examine and critique competing theories of human behavior and show where, how and why they are dead wrong. We could even dig into why PCT hasn't yet come to dominate thinking about human behavior and performance. But those are all matters for another time and place. This is a PCT primer, not an exhaustive explanation of the theory and all related matters. So, that's it for now – except for the recommended readings below.

Recommended Readings

1. Powers, William T. (1973). *Behavior: The Control of Perception*. Aldine de Gruyter: New York, NY.
2. _____ (1989). *Living Control Systems: Selected Papers of William T. Powers*. Benchmark Publications: New Canaan. CT.
3. _____ (1992). *Living Control Systems II: Selected Papers*. Benchmark Publications: New Canaan, CT
4. _____ (1998). *Making Sense of Behavior: The Meaning of Control*. Benchmark Publications: New Canaan.

About the Author

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