Published in final edited form as:

Psychol Inq. 2018 ; 29(3): 139–144. doi:10.1080/1047840X.2018.1513681.

Control Theory, Goal Attainment, and Psychopathology

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In this issue Colin DeYoung and Robert Krueger (hereafter DK) suggest that cybernetic principles can provide a grounding for a general theory of psychopathology, and they propose one such theory. I agree with the first point, but I see the grounding a little differently than they do. This comment addresses several issues discussed by DK. First, I consider in general terms what a cybernetic viewpoint brings to the analysis of behavioral problems, from my own point of view. Then I consider how the five factor model of personality may embody cybernetic properties, and how I see the five factors as relating to disorder. Finally, I address a topic that seems to be largely left out of the discussion of cybernetics and psychopathology, but which seems obviously relevant to psychopathology: the experience of confidence and doubt.

Control Theory

Most of my career has been spent viewing human behavior from the implicit vantage point of cybernetics, or control theory (Miller, Galanter, & Pribram, 1960; MacKay, 1966; Powers, 1973; Toates, 2006; Wiener, 1948), as I understand those ideas. From this, it should be obvious that I regard control theory as a useful perspective. Its invocation conveys a variety of things about behavior that are not necessarily conveyed by other labels: the sense of a set of purposive processes, involving self-corrective adjustments as needed, and the sense that the adjustments originate within the person.

Goal Based Behavior

In several respects, these ideas overlap with the theme that behavior is goal-directed. The reference value (comparison point) used by a feedback loop can be thought of as its goal: It is the state of affairs the loop is trying to bring into existence. Actually, contra DK, not all feedback loops have represented goals (Carver & Scheier, 2002; Ramsay & Woods, 2014), but it is generally convenient to assume that the feedback loops involved in human action do. It's probably best to leave teleology out of the stories we tell ourselves about weather systems and thermostats (which appear to behave according to cybernetic principles), but it's probably useful to include it in the stories we tell ourselves about what kind of creatures we are. For the purposes of this essay, reference values are treated as roughly equivalent to goals. I concur with DK (and many others) that many of these goals are not readily accessible to consciousness.

One might choose to proceed solely in terms of goal pursuit (and threat avoidance), but DK have chosen to go a step further and invoke cybernetics as the metatheory underlying their ideas (as have I). I think the elements cybernetics adds, even if only by implication, are important. Any goal directed behavior presumably entails having a desired end that one wants to attain (the goal) and the ability to create actions that will cause the present situation to change in desired ways (action). But control theory adds the explicit assumption that such regulation also entails perceiving what the present circumstance is with respect to the goal, and assessing whether this circumstance does or does not currently match the goal. Being able to influence present conditions would be of little help in itself if the other functions were not also operating.

In a way, this is the essence of what a cybernetic view brings to the table: It forces the realization that all of those functions are necessary for successful goal pursuit, not just the capacity to imagine an outcome and emit an action. It forces the realization that action occurs in service to changing the input (Powers, 1973). It creates the sense that approach and avoidance are regulatory activities rather than just ballistic reflexes.¹

I have in the past devoted some attention to what cybernetic concepts bring to the analysis of psychopathology (Carver & Scheier, 1998, Chs. 12, 13, and 16), though I have done so recently. Surely if these concepts provide a useful view of normal behavior, they ought to have something to say about problems. I think about problems in terms of ways in which normal functions can go awry. For the most part, things go awry when the system's functioning is either at some sort of extreme or is subject to bias in some way. These two things can happen at several places in control systems.

Elements of Feedback Control and Sources of Problems

To expand on that statement, let me turn to the feedback loop (Figure 1). Its various elements—input function, reference value, comparison function, and output function—all have at least one or two parameters that can greatly affect the overall functioning of the whole loop. If one of those parameters is distorted, problems can result. Delineation of such problems could be viewed as applying cybernetic ideas to psychopathology. Here are my thoughts on that issue (thoughts that share some themes, but not all, with those of DK).

I start with the input function—the sensing of a current condition. More specifically, the input function represents my perception of the present situation regarding me and my goal. (Note that it's hard to talk about this function without taking the next one into account as well; it's not just perception of any old thing, but perception of a current situation that matters for some goal).

This function is subject to a range of biases. We appear not to perceive much of anything in life exactly as it really is, but rather through the distortions of various prisms that are either built in or acquired through a lifetime of trying to create a model of reality. One major

¹I am fine with talking in terms of goals, though I generally retain these cybernetic overtones even then. In fact, I sometimes use goal language intentionally because I worry that the term “cybernetic” puts some people off. Some of its initial connotations (Wiener, 1948) have faded and other connotations, generally unconnected to the original ones, have arisen. I worry that the strengths of a cybernetic perspective are sometimes disregarded just because the word has come to have distracting connotations.

source of psychological problems (from minor to severe) is understanding one's present situations in ways that deviate substantially from the consensual understanding of other people (as when you think Susie is attracted to you, but it is clear to everyone else that she is not) or even deviates from physical reality (as when the gas gauge is on "empty" and you perceive yourself as a mile away from the gas station that really is 10 miles away).

A variation on this general theme is attending to the wrong feedback channel: information that you think is relevant but actually isn't (Carver & Scheier, 1998, Ch. 12). For example, having the boss smile at you when passing in the hallway does not necessarily inform you about his opinion of your work. Another variation is just not paying attention to the present situation at all—as when an anger-prone person fails to realize he is displaying angry.

There are obviously many ways to misinterpret the situation one is in, and a good proportion of that misinterpretation concerns how you think you are doing with respect to various goals you have. This general notion—that people sometimes have distorted views of their current situations—does not require a cybernetic analysis (it is fundamental to the cognitive-behavioral view of problems), but it fits such an analysis nicely. When I say this, by the way, I am saying that the *consequences* of having distortion fit the cybernetic model, not the process of creating the distortion, which I take to be outside the cybernetic framework per se.

Next the reference value. As suggested earlier, the reference value used by a feedback loop can be thought of as its goal, the state of affairs it is organized to realize in current reality. Goals are also subject to distortion, and as noted, many goals are not readily accessible. If our goals are sometimes impenetrable to introspection, it stands to reason that we are sometimes unsure what exactly we are trying to accomplish. If we are mistaken about what we are trying to do (we think it's succeeding at our career, when it's really trying to make our father proud of us), that creates one kind of problem.

Another problem is that goals can be unrealistically lofty. If you insist on perfection, you will have difficulties in life. Another kind of problem arises when we simply don't know what goals apply in a given situation, or when we adopt a context-inappropriate goal (as when a narcissist adopts the goal of obtaining admiration when that goal is objectively inappropriate to the behavioral context). Yet another problem is that one can choose a goal that is actually inimical to one's life-space of goals: its attainment may interfere with another, possibly more important, goal. So there are many ways in which problems can arise in the mere specification of a reference value. Again, however, what is cybernetic here is the goal and how distortions in it can create regulatory problems, not the process of distorting per se.

Next is the comparison function. The way to tell whether you are doing what you intended to do (or want to do) is to check whether the present state created by your actions up till now (i.e., input function) conforms to the state you intended (reference value). This comparison function seems simple enough. One way in which it becomes more complicated would be to think about variations in its calibration, from highly precise (you have to park your car precisely between the white lines to conclude "yes, it matches"), to very sloppy (you're at a

diagonal but no metal has been bent, so “yes, it matches”). Perfectionism can be a problem (as when a depressed person is overly harsh about where she stands in comparison to a goal). Problems are also created by regulating so loosely that other people can’t tolerate interacting with you (think about perceiving that you gave your spouse credit publicly for something you achieved together when you have hardly mentioned it).

Perceived discrepancy between input and goal leads to a change in output. The output function ultimately translates to behavior, though the behavior not need be overt. It does, though, need to be something that potentially changes your perception of your current state in the world vis a vis your goal. After all, the point of the output function is to move your perceived state into greater conformity with the reference value. It’s very easy to see problems arising in the output function: For example, sometimes you don’t know of any action that will move you toward the desired state, in which case you either flounder or are paralyzed in inaction. Or you may doubt your ability to do what you think is the right thing (Bandura, 1977) and again you are paralyzed in inaction.

This sort of difficulty is particularly easy to point to when you add in the notion of hierarchical control, in which superordinate goals are reached by moving toward more concrete subordinate goals (see also Carver & Scheier, 1998, Ch. 13). A key skill in life is knowing how to disaggregate abstract goals into concrete ones, but that skill is not well developed in everyone. A deficit here means not having concrete goals to deploy in the effort to get to an abstract goal. Again, however, this idea is not unique to control theory. Not knowing what actions are appropriate to the perceived current situation is another major source of problems from a cognitive-behavioral viewpoint.

Feedback Loops, Goals, and Dimensions of Personality

In principle, all of the issues raised in the previous section can be tied to control theory (though many need not be), and all can occur with respect to any feedback loop that might be embedded in human behavior. DK argued that these principles can be applied to the five factor model of personality, thereby indicating broader relevance. I can see some potential mapping, but my view of it is a little different from theirs. In this section I consider the five-factor model from the perspective I’ve outlined thus far.

DK tend to see the five factors as reflecting different cybernetic parameters. In contrast, I see them as reflecting mainly different classes of goals. One reason for this difference may be that our views of the five-factor model derive from different lines of thought and experience. DK come from a long tradition of psychometrics, plus many years of “sociopolitical negotiation” with other psychopathologists over the view that dimensions may underlie diverse categories of disorder. I, on the other hand, drifted from control theory into a goal-regulation framework, in which a key question was what kind of goal was operating at a given time. From control theory (among other sources, of course) comes the principle that some values are approached and others are avoided. From social and personality psychology (writ large) come ideas about categories of goals that might be particularly important to the human experience.

So what do I think the five factors are about? For the most part, I think they are about individual differences in temperamental sensitivities to varying classes of goals. Throughout this discussion I will refer to sensitivities: variations in the extent to which a given stimulus typically provokes a response in the person. I am not referring to variation in temporary engagement in goal pursuit, though that view could of course also be brought to bear.

I concur with DK that extraversion appears to reflect a very broad motivation to approach incentives. Extraversion may have an inherent bias toward social incentives, perhaps in the form of desire for social dominance, but it seems a good deal broader than just social dominance. I think of extraversion as a broad approach trait.

I do not concur with DK that neuroticism is fundamentally about negative affect (which is the first characterization they provided for it), but rather about the avoidance of threat (which they also say later in their article). In my view, threat sensitivity is this trait's core and the high salience of negative valence that characterizes measures and discussions of neuroticism is partly misleading. Why is this negativity so salient? Because negative valence often arises when facing threat. The more sensitive a person is to threat, the more frequently threat-related negative valence will be elicited. On the other hand, it must also be realized that when avoidance is successful, greater threat sensitivity can yield greater *positive* valence (Carver, 2009). Thus, positive as well as negative affect can be tied to threat sensitivity. I also think some of what gets swept up into neuroticism does not fully belong there. For example, there is a good deal of evidence that anger is grounded in the approach function rather than the threat function (Carver & Harmon-Jones, 2009a).

The notion that positive valence can be linked to avoidance, and negative valence can be linked to approach, is not at all a problem to me, because I think valence has a different origin and a different meaning than most other people seem to think. Now that I've put my foot into valence, let me say more plainly what I think about it (for broader treatment see Carver & Scheier, 2013).

Humans have an incentive approach system (extraversion) and a threat avoidance system (neuroticism), each of which has a broad class of goals (one concerning approach, the other concerning avoidance). Each of these broad systems can, at any given time, be doing a good job at what it is engaged in (obtaining incentives or evading threat) or it can be doing a bad job. Thus, each of them can be responsible for either positive affect or negative affect (Figure 2; Carver & Scheier, 1990, 1998). Analysis of affects needs to take more than valence and arousal into account. It needs to take into account what broad function the affect pertains to (see also Carver & Harmon-Jones, 2009a, 2009b).

Back to extraversion and neuroticism and their relevance for psychopathology. Here the theme of extremity stands out to me. A highly sensitive incentive system can help render a person vulnerable to various kinds of problems that involve intense pursuit of incentives (Carver et al., 2008; Carver et al., 2017; Johnson, Carver, & Joormann, 2013). Mainly these will be externalizing problems, including substance use and violence (Krueger & Markon, 2006), but not entirely—mania is also characterized by an overactive approach system (Johnson, 2005; Johnson, Edge, Holmes, & Carver, 2012; Urosevic, Abramson, Harmon-

Jones, & Alloy, 2008). A blunted or insensitive approach system can help render the person vulnerable to the kinds of problems that involve absence of motivation and engagement: depression and distress-misery (Cox, Clara, Hills, Sareen, 2010; Krueger, 1999; Watson, 2005). Thus, being at either extreme of sensitivity on extraversion can be problematic, because of issues pertaining to the approach of incentives.

Extremes on either end of the threat avoidance system can also create problems. Most obviously, a very sensitive threat system will help render the person vulnerable to development of anxiety disorders. But a very blunted threat system can help render the person relatively immune to fear, and thus vulnerable to psychopathic tendencies.²

What about the other traits? At least two of the remaining three can be viewed as variations on the tendency to approach. Agreeableness concerns valuing relationships and acting to keep relationships in good order (Graziano & Eisenberg, 1999). This is an approach tendency, but with a more restricted set of goals than extraversion has. Disagreeableness means disregarding these goals (perhaps even actively opposing and disparaging them, though I am not aware of information on this possibility).

I would agree with DK's suggestion that Openness reflects multiple properties. I agree that part of this trait seems to be engagement in an active approach of uncertainty, with the implicit (and maybe explicit) goal of enhancing certainty. A person high in this trait is seeking experiences that are not readily assimilated. By assimilating them to one's current knowledge, one accommodates one's mental schemas to the information the experiences provide, and thereby becomes more complex and integrated (Piaget, 1971). Becoming more complex and integrated (or, as DK said, having one's entropy reduced), and thus able to assimilate further experiences of ever-greater diversity, is perhaps the ultimate goal of the organism. I see this as an approach goal, of a particular class.

I have left Conscientiousness for last, partly because I think it is more complicated than I once did. It has multiple facets (Jackson et al., 2010), which have somewhat different implications. From a cybernetic view, one might view conscientiousness as a trait that embodies precision versus sloppiness in the comparison function of a feedback loop, as discussed earlier. But that seems a bit of a stretch. Really, the central theme of conscientiousness seems to be tendencies to prioritize goals and follow rules (though it might be claimed that these are just abstract ways to be precise). These are adaptive properties and, as DK noted, they are associated with lower risk of psychopathology, particularly externalizing psychopathology (Krueger & Markon, 2006).

But I need to add one more thing here. In any complicated or multifaceted construct or measure, some bits invariably get left out. For example: I am involved in a project examining variations in the tendency to respond reflexively to emotional states (not the having of weak vs intense emotions, but being more responsive behaviorally or cognitively when emotions

²Depressed affect may be the most complicated case to attribute in this view. It arises in the context of loss of an incentive or removal of a goal (approach-related), but also in the context of confirmed inability to escape a punishment (avoidance-related). Are these two experiences of depressed affect the same or different? I suspect different, but subtly so.

occur). A tendency to refrain from overreacting to emotions would seem to be part of conscientiousness, though I know of no measure of conscientiousness that focuses on it.

This tendency turns out to be associated with both externalizing problems and internalizing problems (Carver, Johnson, & Timpano, 2017); there is even evidence that these associations are more robust than are those for other facets of impulsivity (Berg et al., 2015). We now suspect that an over-responsiveness to emotion may be an important transdiagnostic liability for psychopathology when combined with extremity on another of the core traits that likely yield frequent emotions to respond to (e.g., approach or avoidance temperament).

My colleagues and I have interpreted this variation in reactivity to emotion via a dual process model that posits a competition between two sources of guidance for behavior, one associative and more primitive (and responsive to emotions), the other more rule based and abstract (for detail see Carver et al., 2017; Carver & Scheier, 2017). This interpretation can be tentatively linked to a cybernetic view—or, more particularly, to the hierarchical organization of feedback processes proposed by Powers (1973). Dominance of the reactive level of the dual process model appears to correspond to cases in which the level Powers (1973) called Sequence control is functionally superordinate. Dominance of the deliberative level of the dual process model appears to correspond to cases in which what the levels Powers called Program and Principle control are functionally superordinate.

In the past we have often noted that which level of the Powers hierarchy is functionally superordinate can vary across situations and persons (e.g., Carver & Scheier, 1998). That is, it is easy to imagine cases in which a person is behaving according to a principle (e.g., a moral or ethical value), and it is easy to imagine cases in which the person is behaving according to a program. It is also easy, however, to imagine cases in which the person is acting impulsively and spontaneously, without regard to either principle or plan. In the past, our emphasis generally was on how sequences and plans differ. But this reasoning also seems readily applicable to the dual process models we have used to address this aspect of conscientiousness. So perhaps a link exists in this form from cybernetics to conscientiousness.

Confidence, Doubt, and Psychopathology

The last thing I want to address here pertaining to psychopathology also does not seem to have much to do with control theory, as far as I can tell. Many of the issues that I raised in the section on control processes and problems also suggest the emergence of doubt about being able to move forward, or even a conviction that you cannot move forward. The dimension of confidence versus doubt is involved in a very wide range of psychopathology. Certainly, any time there is a comorbidity of depression with anything else, this is a core issue. Likely the same is true of a comorbidity of anxiety.

The essence of my view of the effect of confidence versus doubt on approach is shown in Figure 3. This figure shows variation in how well the person is doing with respect to the relevant goal, along with a reference value (at which affective valence would be neutral) marked by a dotted line (these are all seen in terms of velocity of goal attainment rather than

states, but that issue does not particularly matter here; for further discussion see Carver & Scheier, 1998, 2013). The figure was originally drawn to illustrate placement of several approach-related affects on the dimension of how well approach is going (across the top) and the predicted degree of behavioral engagement at varying points on that dimension. However, the affects themselves are also linked to degree of confidence versus doubt about eventual goal attainment. Thus, one might also attach those labels to the x axis, as is done in Figure 3.

Theory predicts that engagement is high at around the criterion (to maintain progress) and in a range below it (to try to regain progress), but if things are going too badly (far right side), effort falls off. When an incentive is lost altogether, effort ceases. In adaptive self-regulation, the person in this situation gradually disengages not only from effort, but also from commitment to the goal (Carver & Scheier, 2003). Further issues also intrude here as well. If the goal is important, it is important to take up another one (Carver & Scheier, 2003; Wrosch, Scheier, Miller, Schulz, & Carver, 2003), especially if the one that's lost plays an important role in attainment of a more abstract goal or value. But people do not always do so, resulting in failure to move toward any goal in that domain.

These issues also play an important role in DK's description of the very nature of psychopathology. Indeed, they define psychopathology as "a persistent failure to move toward one's goals, due to failure to generate effective new goals, interpretations, or strategies when existing ones prove unsuccessful." They call this cybernetic dysfunction. I agree it is dysfunction, but I'm less sure what's cybernetic about it, other than the fact that goals, perceptions, and outputs are what the cybernetic system uses as its data. There is certainly a great deal of cognitive work being done to create those goals, perceptions, and outputs, but I don't think of that background work as being part of the control loop, but rather as part of the staging within which control processes run.

Further, although doubt can certainly play a role in producing "a persistent failure to move toward one's goals," I don't see where doubt comes into play in the control loop except indirectly. That is, doubt might interfere with the attempt to generate a new goal or to carry out a sequence of behavior, but it's the goal and the engaged behavior that are part of the control process. Further, if doubt causes reduction or stoppage of effort, I see nothing intrinsic to control theory that would predict that the person now disengages from the lost goal. (A thermostat that can't get the furnace to keep up with the falling temperature doesn't quit trying, no matter how far the temperature goes below the set point.) Ideas can be proposed that provide potentially useful ancillaries to a control-process view here, but they mostly do seem like ancillaries.³

In sum, a perceived inability to move forward toward one's desired endpoint (the right side of Figure 3), the emotional distress associated with such perceived inability, the giving up of effort to move forward—all these are very important to psychopathology. However, is not

³As in my discussion of conscientiousness, a link may be derived from the idea that feedback loops are organized hierarchically, with many goals in play simultaneously, along with continual juggling of the priorities afforded to each (Carver, 2003). From that view, turning away from one goal (even if one is failing at it) so as to pursue a different goal may represent a change in priority ranking rather than giving up. That might solve the problem of how to fit disengagement into a control-theory framework.

fully clear to me (footnote 3 notwithstanding) how this collection of elements relates to cybernetics. They are important, but they seem to me to be generally outside the “focus of convenience” of this particular interpretive framework. On the other hand, they do fit nicely with psychology’s long tradition of expectancy-value theories of goal pursuit. Somewhat ironically, then, in light of my earlier comments about how control theory brings something important to a goal-based perspective, here is a case in which the goal-based perspective may bring something useful to control theory.

Closing Comment

To summarize my position, I think control theory brings important connotations to the idea that behavior reflects the approach of incentives and avoidance of threats. My own view of the window that these ideas provide on psychopathology shares space with that of DK, but also differs from theirs in several ways. Nonetheless, I applaud their effort to bring attention to the contribution that this meta-theory makes to conceptualizing the functional underpinnings of the psychological and behavioral problems that plague so many people.

Acknowledgement

My thanks to Sheri L. Johnson for suggestions on an earlier draft.

Funding

Preparation of the manuscript was facilitated by grants 1R01MH110477 and 1R01NR016838.

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Figure 1.
Generic depiction of a feedback loop.

Figure 2. Dimensions of approach related and withdrawal related affects postulated by Carver and Scheier (1998, 2013). The crossing point in this diagram represents neutral points on both dimensions.

Figure 3.

Hypothesized approach-related affects as a function of doing well versus doing poorly compared to a reference value. A second (vertical) dimension indicates the degree of behavioral engagement posited to be associated with affects at different degrees of departure from neutral. Adapted from C. S. Carver, 2004, Negative affects deriving from the behavioral approach system. *Emotion*, 4, 3–22.