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Action, Affect, Multi-tasking, and Layers of Control

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This chapter describes several aspects of the view we take on the self-regulation of action and affect. It begins with the idea that two layers of feedback processes manage two different aspects of behavior. We believe that they operate together in a way that allows people to juggle multiple tasks across time and also conserve resources. Thus, diverse simultaneous motives are transformed into a stream of actions that shifts repeatedly from one goal to another.

During the last couple of decades, many changes have occurred in views of cognition and action. The implicit assumption that behavior is generally managed in a top-down, directive way has been challenged. Interest has grown in the idea that the mind holds implicit representations as well as explicit ones. These various ideas are inducing a different way of construing diverse functions of the brain that underlie the control of action. In the later part of the chapter we consider some aspects of this emerging view.

A word about terminology. The term *self-regulation* means different things to different people. We have long used it to convey a sense of self-corrective adjustments taking place as needed, so that behavior stays on track for the purpose to which it is directed. In this view, behavior is a continuing process of moving toward goals and away from threats To others, the term *self-regulation* implies the additional quality of overriding or restraining prepotent impulses (Baumeister & Vohs, 2004). When we wish to convey the latter, we use the more restrictive term *self-control*.

Behavior As Goal Directed and Feedback Controlled

People have many goals, at varying levels of abstraction and importance. The goal concept is broad enough to cover both long-term aspirations (creating and maintaining a good impression among colleagues) and the endpoint of very short-term motions (e.g., engaging a turn signal while driving). Most goals can be reached in diverse ways, leading to the potential for vast complexity in the organization of action.

We have long held that movement toward a goal reflects the functioning of a feedback

loop: perception of present conditions being compared to a desired or intended condition, and any discrepancies noted being countered by subsequent action. There also are discrepancy enlarging loops, in which deviations from the comparison point are increased rather than decreased. The value in this case is a threat, an "anti-goal."

Effects of discrepancy enlarging processes in living systems are typically constrained by discrepancy reducing processes. Put differently, acts of avoidance often lead into other acts of approach. An approach loop pulls the avoidance behavior into its orbit. This pattern of dual influence is seen in active avoidance. An organism fleeing a feared stimulus picks a relatively safe location to escape to, and approaches that location.

People sometimes infer from specific examples that feedback loops can act only to create and maintain steady states. Some reference values (and goals) *are* static end states. But others are dynamic (e.g., taking a vacation, raising children to be good citizens). In such cases, the goal is the process of traversing the changing trajectory of the activity, not just the arrival at the end point. Feedback processes apply readily to moving targets (Beer, 1995).

Levels of Abstraction

It is often said that goals form a hierarchy (Carver & Scheier, 1998; Powers, 1973; Vallacher & Wegner, 1987). Abstract goals are attained by attaining the concrete goals that help define them. Lower-level goals are defined by brief sequences of action (each of which could be further broken down into subcomponents of motor control, e.g., Rosenbaum, Meulenbroek, Vaughan, & Jansen, 2001). Sequences have a self-contained quality about them; they require little monitoring once they are triggered.

Such sequences can be organized into more elaborate strings of actions, which Powers (1973) called programs. These are more planful and often require that choices be made at various points along the way. Programs, in turn, are sometimes (though not always) enacted in the service of broader principles. Principles are abstractions that can provide a basis for making

decisions within programs and can suggest that certain programs be undertaken or be refrained from. Principles are the sorts of entities that are sometimes called values (Schwartz & Bilsky, 1990; Schwartz & Rubel, 2005). What defines a principle is its abstraction, rather than whether it is socially desirable. For example, different principles can lead people to support affirmative action or to oppose it (Reyna, Henry, Korfmacher, & Tucker, 2006).

Even values are not the end of potential complexity. Patterns of values can coalesce to form a sense of desired (and undesired) self, or a sense of desired (and undesired) community. All these classes of goals, from very concrete to very abstract, can be seen as potential reference points for self-regulation.

Feedback Processes and Affect

Action control is partly about movement, but it is partly about relative urgency or intensity. Urgency implies affect, feelings during action. What is affect? Where does it come from? Affect is a feeling state that pertains to whether one's desires are being met (Clore, 1994; Frijda, 1986, 1988; Ortony, Clore, & Collins, 1988). But what internal mechanism yields affect?

We hypothesized a mechanism that highlights certain functional properties of affect (Carver & Scheier, 1990, 1998), again using feedback control as an organizing principle. Now, though, the control bears on a different quality. We suggest that feelings arise from a feedback loop that operates simultaneously with and in parallel to the behavior-guiding loop. The easiest characterization of what this second process does is that it checks on how well the first process is going. The input for this second loop thus is the *rate of discrepancy reduction in the action system over time*. (We focus first on discrepancy reducing loops, then enlarging loops.)

Input (how well you are doing) does not create affect by itself. A given rate of progress has different affective consequences in different contexts. We assume this input is compared to a standard (cf. Frijda, 1986, 1988) as in other feedback systems—in this case, an acceptable or expected rate of behavioral discrepancy reduction. As always, the comparison assesses deviation

from the standard. If there is a discrepancy, an error is sensed and the output function changes. We assume that the testing for error is continuous and automatic.

We think the error signal in this loop (indicating a discrepancy) is manifest as a sense of positive or negative valence. A rate of progress below the criterion yields negative affect. A rate high enough to exceed the criterion yields positive affect. If the rate is not distinguishable from the criterion, there is no valence. In essence, the argument is that feelings with positive valence mean you are doing better at something than you need to, and feelings with negative valence mean you are doing worse than you need to.

One direct implication of this argument is that the affective valences that might potentially occur for any activity should fall on a bipolar dimension. That is, it should be the case that affect can be positive, neutral, or negative for any goal-directed action, depending on how well or poorly it is going. This differentiates our view from some others, an issue we take up a bit later.

What determines the criterion? The criterion is probably quite flexible when the activity is unfamiliar. If the activity is familiar, the criterion is likely to reflect the person's accumulated experience, in the form of an expected rate (the more experience you have, the more you know what is reasonable to expect). Whether "desired" or "expected" or "needed" is most accurate as a depiction of the criterion rate may depend greatly on the context.

The criterion can also change. The less experience the person has in a domain, the more fluid the criterion. In a familiar domain, change occurs more slowly. Continuing overshoots automatically yield an upward drift of the criterion, continuing undershoots yield a downward drift (see Carver & Scheier, 2000). Thus, the system recalibrates over repeated experiences. An ironic effect of such recalibration would be to keep the balance of a person's affective experience (positive to negative) relatively similar, even when the rate criterion changes considerably.

Two Types of Action, Two Dimensions of Affect

Our view is that feeling exist when a behavioral system is making more or less than adequate progress *doing what it is organized to do*. The systems addressed so far work to reduce discrepancies. Yet there seems no obvious reason why the principle should not apply to systems that enlarge discrepancies. If that system is making rapid enough progress attaining its end, there should be positive affect. If it is doing poorly, there should be negative affect.

This implies that both approach and avoidance have the potential to induce positive feelings (by doing well), and both have the potential to induce negative feelings (by doing poorly). But doing well at *approaching an incentive* is not quite the same experience as doing well at *moving away from a threat*. Are there differences between the two positives, and between the two negatives?

Drawing on insights of Higgins (e.g., 1987, 1996) and collaborators, we postulate two bipolar dimensions of affect, one bearing on approach, the other on avoidance (Carver, 2001; Carver & Scheier, 1998). Approach-related affect includes such positive affects as elation, eagerness, and excitement, and such negative affects as frustration, anger, and sadness (Carver, 2004; Carver & Harmon-Jones, 2008). Avoidance-related affect includes such positive affects as relief, serenity, and contentment and such negative affects as fear, guilt, and anxiety.

Affect and Action: Two Facets of One Event in Time

This two-layered view implies a natural connection between affect and action. That is, if the input function of the affect loop is a sensed rate of progress in action, the output function of the affect loop must be change in the rate of progress in that action. Thus, the affect loop has a direct influence on what occurs in the action loop.

The idea of two feedback systems functioning jointly turns out to be common in control engineering (e.g., Clark, 1996). Having two systems functioning together—one controlling position, one controlling velocity—permits the device they control to respond in a way that is both quick and stable, without overshoots and oscillations. The combination of quickness and

stability in responding is desirable in people, as well as in machines. Someone very reactive emotionally is prone to overreact, and oscillate behaviorally. Someone who is emotionally nonreactive is slow to respond even to urgent events. One whose reactions are between those extremes responds quickly but without overreaction and oscillation.

Being able to respond quickly yet accurately confers a clear adaptive advantage. We think that quick yet stable responding is a consequence of having both behavior-managing and affect-managing control systems. Affect makes people's responses quicker (because this system is time sensitive); as long as the affective system is not over-responsive, the responses are also stable.

Our focus here is on how affects influence behavior, emphasizing the extent to which they are interwoven. Note, however, that the behavioral responses related to the affects also lead to *reduction of the affects*. Thus, in a very basic sense, the affect system is self-regulating. Certainly people make voluntary efforts to regulate their emotions, but the affect system does a good deal of that self-regulation on its own.

Affect Issues

This view differs from others in at least two important ways. One difference concerns the possible dimensional structure of affect. Our view holds that affect relating to approach has the potential to be either positive or negative and that affect relating to avoidance has the potential to be either positive or negative. This differs from most other dimensional models of affect.

The idea that eagerness, excitement, and elation relate to approach is not controversial. Nor is it controversial that fear and anxiety relate to avoidance. Consensus breaks down, however, on how to view other affects. For example, Gray (e.g., 1990, 1994b) held that the same system is engaged by both cues of punishment and cues of frustrative non-reward. It thus creates negative feelings pertaining to approach as well as negative feelings pertaining to avoidance. Similarly, he held that the approach system is engaged by cues of reward and cues of escape or avoidance of punishment. It thus is linked to positive feelings, whether pertaining to avoidance or approach.

In that view, each system is responsible for affect of one valence. It yields two unipolar affective dimensions, each linked to the functioning of a behavioral system. A similar position has been taken by Lang and colleagues (e.g., Lang, 1995; Lang, Bradley, & Cuthbert, 1990), by Cacioppo and colleagues (e.g., Cacioppo & Berntson, 1994; Cacioppo et al., 1999), and by Watson and colleagues (Watson et al., 1999). In that respect, our dimensional view is quite different from those that dominate today's discussions.

Evidence of Bipolar Dimensions

What does the evidence say? Consider "doing well" at threat avoidance. Higgins, Shah, and Friedman (1997, Study 4) found that an avoidance orientation to a task (instructions to avoid failing) plus a good outcome led to elevations in reports of calmness. An effect on this affect did not occur, however, with an approach orientation (instructions to succeed). This suggests that calmness is linked to doing well at avoidance, rather than doing well at approach. Other research asked participants to respond to hypothetical scenarios in which a threat was introduced and then removed (Carver, in press). Reports of relief related to individual differences in threat sensitivity, only secondarily to differences in incentive sensitivity.

A larger accumulation of evidence links certain negative affects to "doing poorly" in approaching incentives, a few of which are noted here. The study by Higgins et al. (1997) just described also provided data on sadness. With an approach orientation, failure elevated sadness. This did not occur with an avoidance orientation. The pattern suggests a link between sadness and doing poorly at approach, rather than doing poorly at avoidance.

The broader literature of self-discrepancy theory also makes a similar point. Many studies have shown that sadness relates uniquely (controlling for anxiety) to discrepancies between actual selves and ideal selves (see Higgins, 1987, 1996, for reviews). Ideals are qualities the person intrinsically desires: aspirations, hopes, positive images for the self. There is evidence that pursuing an ideal is an approach process (Higgins, 1996). Thus, this literature also suggests

that sadness stems from a failure of approach.

Another study (Carver, 2004) led participants to believe they could obtain a reward if they performed well on a task. All received feedback that they had not done well, however, and they thus failed to obtain the reward. Reports of sadness and discouragement at that point related to pre-measured sensitivity of the approach system, but not to sensitivity of the avoidance system.

There is also evidence linking the approach system to the negative affect of anger. Harmon-Jones and Allen (1998) studied individual differences in trait anger. Higher anger related to higher left frontal activity (and lower right frontal activity). Because the approach system has been linked to activation of the left prefrontal cortex (e.g., Davidson, 1992), this suggests a link between anger and the approach system. Harmon-Jones and Sigelman (2001) later induced anger in some persons but not others, then examined cortical activity. They found elevations in left frontal activity, again suggesting that anger relates to engagement of the approach system.

Further evidence pertaining to anger comes from research (Carver, 2004) in which people indicated the intensity of feelings they experienced in response to hypothetical events (Study 2) and after the destruction of the World Trade Center (Study 3). Reports of anger related to pre-measured sensitivity of the approach system, whereas reports of anxiety related to sensitivity of the avoidance system (for more extensive review see Carver & Harmon-Jones, 2008).

In sum, evidence links certain positive affects to the avoidance system and certain negative affects to the approach system. This evidence has implications for the attempt to identify a mechanism for creation of affect. Theories postulating two unipolar dimensions appear to assume that greater activation of a system translates directly to more affect of that valence (or more potential for affect of that valence). If the approach system relates both to positive and to negative feelings, such a direct transformation of system activation to affect is not tenable.

A conceptual mechanism is needed that naturally addresses both positive and negative

feelings within the approach function (and, separately, the avoidance function). The mechanism described here does so. Its mechanism fits nicely with the fact that feelings occur continuously throughout the attempt to reach an incentive, not just at the point of its attainment. Indeed, feelings rise, wane, and change valence, as progress varies from time to time along the way.

A Counterintuitive Implication

A second issue also differentiates this view from many others (Carver, 2003). Return to the argument that affect reflects the error signal from a comparison in a feedback loop. Affect thus would be a signal to adjust rate of progress. This would be true whether the rate is above the mark or below it—whether affect is positive or negative. For negative feelings, this view is fully intuitive. If the person tries harder—and assuming that more effort (or better effort) increases the rate of intended movement—the negative affect diminishes or ceases.

What about positive feelings? Here prediction becomes counterintuitive. In this model, positive feelings arise when things are going better than they need to. But the feelings still reflect a discrepancy (albeit a positive one), and the function of a negative feedback loop is to minimize discrepancies. Such system is organized in such a way that it "wants" to see neither negative nor positive affect. Either quality (deviation from the standard in either direction) would represent an "error" and lead to changes in output that would eventually reduce it (see also Izard, 1977).

This argues that people who exceed the criterion rate of progress (and who thus have positive feelings) will automatically tend to reduce subsequent effort in this domain. They will "coast" a little—not necessarily stop, but ease back, such that subsequent progress returns to the criterion. The impact on subjective affect would be that the positive feeling itself is not sustained for very long. It begins to fade.

Expending effort to catch up when behind, and coasting when ahead, are both presumed to be specific to the goal to which the affect is linked. Usually (though not always) this is the goal from which the affect arises in the first place. We should also be clear about the time frame

involved. This view pertains to the current, ongoing episode of action. This is *not* an argument that positive affect makes people less likely to do the behavior again later on.

A system of this sort would operate in the same way as a car's cruise control. If progress is too slow, negative affect arises. The person responds by increasing effort, trying to speed up. If progress is better than needed, positive affect arises, leading to coasting. A car's cruise control is similar. A hill slows you down; the cruise control responds by giving the engine more fuel, speeding back up. If you come across the crest of a hill and roll downward too fast, the system cuts back on fuel and the speed drags back down.

The analogy is intriguing partly because both sides have an asymmetry in the consequences of deviation from the reference point. That is, in both cases, addressing the problem of going too slow requires adding resources. Addressing the problem of going too fast entails only cutting back on resources. The cruise control does not engage the brakes, it reduces fuel. The car coasts back to the velocity set point. Thus, the effect of the cruise control on a high rate of speed depends in part on external circumstances. If the hill is steep, the car may exceed the cruise control's set point all the way to the valley below.

In the same fashion, people usually do not react to positive affect by actively trying to make themselves feel less good. They just ease back a little on resources devoted to the domain in which the affect has arisen. The positive feelings may be sustained for a long time (depending on circumstances), as the person coasts down the subjective hill. Eventually, though, the reduced resources would cause the positive affect to diminish. Generally, then, the system would act to prevent great amounts of pleasure as well as great amounts of pain (Carver, 2003; Carver & Scheier, 1998).

Coasting and Multiple Concerns

Does positive affect lead to coasting? To test the idea, a study must assess coasting with respect to the goal underlying the affect. Many studies have created positive affect in one context

and assessed its influence on another task (e.g., Isen, 1987, 2000; Schwarz & Bohner, 1996), but they do not test this question. Suggestive evidence has been reported by Mizruchi (1991) and Louro, Pieters and Zeelenberg (2007), but at this point the question remains relatively open.

Why would a process be built into the organism that limits positive feelings—indeed, dampens them? There are at least two adaptive bases for this tendency. One lies in a basic biological principle: it is adaptive for organisms not to spend energy needlessly. Coasting prevents needless energy expenditure. A second basis stems from the fact that people have multiple simultaneous concerns (Carver, 2003; Carver & Scheier, 1998; Frijda, 1994). Given multiple concerns, people typically do not optimize their outcome on any one of them, but rather "satisfice" (Simon, 1953)—do a good enough job on each to deal with it satisfactorily. This permits them to handle many concerns adequately, rather than just any one of them.

A tendency to coast would virtually define satisficing regarding that goal. That is, reduction in effort would yield an adequate rate of progress on that goal rather than the best possible. A tendency to coast could also foster satisficing of a broader set of goals. That is, if progress in one domain exceeds current needs, a tendency to coast there would make it easy to shift to another domain, at little or no cost. This would help ensure satisfactory goal attainment in the other domain and ultimately across multiple domains.

Continued pursuit of one goal without let-up, in contrast, can have adverse effects. Continuing a rapid pace in one arena may sustain positive affect in that arena, but by diverting resources from other goals it also increases the potential for problems elsewhere. This would be even more true of an effort to *intensify* the positive affect, because doing that would mean further diverting resources from other goals. Indeed, single-minded pursuit of yet-more-positive feelings in one domain can even be lethal, if it causes the person to disregard threats looming elsewhere.

If positive feelings led to easing back and an openness to shifting focus, such adverse effects would be minimized. Note that this view does not require that people with positive

feelings shift goals. It simply holds that openness to a shift is a consequence—and a potential benefit—of the coasting tendency. This line of thought would, however, begin to account for why people do eventually turn away from what are clearly pleasurable activities.

<div align="center">Priority Management in Self-Regulation</div>

This line of thought implicates positive feelings in a broad function that deserves closer attention: shifting from one goal to another as focal in behavior (Dreisbach & Goschke, 2004; Shallice, 1978). This very important phenomenon is often overlooked. Many goals are under pursuit simultaneously (cf. Atkinson & Birch, 1970; Murray, 1938) but only one can have top priority at any given moment. Though people need to shield and maintain the intentions now being pursued (cf. Shah, Friedman, & Kruglanski, 2002), they also need to be able to shift flexibly among goals (Shin & Rosenbaum, 2002).

An entity with many goals needs a way to rank them and a mechanism to change rankings as necessary (Simon, 1967). Most goals under pursuit are out of awareness at any given moment. Only the one with the highest priority has full access to consciousness. Sometimes events occur during pursuit of that goal that create problems for another goal with a lower priority. Indeed, the mere passing of time can create a problem for the second goal, by threatening its attainment. If the second goal is also important, any emerging problem needs to be taken into account. If the second goal is seriously threatened, a mechanism is needed for changing priorities, so that the second goal replaces the first one as focal.

Negative Feelings and Re-Prioritization

Simon (1967) reasoned that emotions are calls for re-prioritization: that emotion regarding a goal that is out of awareness eventually induces people to interrupt their behavior and give that goal a higher priority than it had. The stronger the emotion, the stronger is the claim being made for higher priority. The affect pulls the out-of-awareness into awareness. Simon did not address the negative affect that can arise with respect to a currently focal goal, but the same principle

seems applicable. This negative affect seems to be a call for an even greater investment of resources and effort in the focal goal than is now being made.

Simon's analysis applies readily to negative feelings such as anxiety and frustration. If you promised your spouse you would go to the post office today and you've been too busy working on a project, the creeping of the clock toward closing time can cause an increase in frustration or anxiety (or both). Neither affect pertains to the work you are doing. Frustration might arise from the potentially unmet obligation (a desired outcome slipping away); anxiety might arise from the potentially angry spouse (a threat coming closer). The greater the potential loss, the greater the frustration; the greater the threat, the stronger the anxiety. The stronger the affect, the more likely it is that the goal it stems from will rise in priority until it comes fully to awareness and becomes the focal reference point for behavior.

Positive Feelings and Re-Prioritization

Simon's discussion of shifting priorities focused on cases of a non-focal goal demanding a higher priority than it now has and *intruding* on awareness. However, there is another way in which priority ordering can shift: The focal goal can *relinquish its place*. Simon acknowledged this possibility obliquely, noting that goal completion terminates pursuit of that goal. However, he did not address the possibility that an as-yet-unattained goal might also yield its place in line.

It may be that positive feelings also pertain to reprioritization, but rather than calling for higher priority, they signal *reduction* in priority of that goal. Positive affect regarding avoidance (relief or tranquility) indicates that a threat has dissipated, no longer requires as much attention as it did, and can now assume a lower priority. Positive feelings regarding approach (happiness, joy) indicate that an incentive is being attained. If it *has* been attained, effort can cease, as Simon noted. If it is not yet attained, the affect signals that this goal could temporarily be put aside (assume a lower priority), because you are doing so well (Carver, 2003).

A case in which a focal goal diminishes in priority is less directive than the case in which a

non-focal goal demands an increase in priority (the demand is specific to one goal). What happens in this case depends partly on what is waiting in line. It depends partly on how the context has changed while you were busy: opportunities for incentives sometimes appear unexpectedly, and people put aside plans to take advantage of such emergent opportunities (Hayes-Roth & Hayes-Roth, 1979; Payton, 1990). It seems reasonable that positive affect should render people more prone to shift goals if something else needs doing.

Sometimes the next item in line is of fairly high priority. Sometimes the situation has changed and a new goal has emerged for consideration. Sometimes neither of these conditions exists. In the latter case, no change would occur, because even the downgrade in priority of the focal goal does not make it lower in priority than the alternatives. Positive affect does not *require* a change in direction. It simply sets the stage for such a change to be more likely. Indirect support for this general line of reasoning comes from several sources (Carver, 2003).

We should be clear that we are not arguing that affect is the only source of shifts in goal reprioritization. For example, changes in context can also produce goal shifts, because different contexts have been linked in the past to different goals. Our argument is simply that affect is part of the prioritization process.

Priority Management and Feelings of Depression

One more aspect of priority management should be addressed, concerning the idea that goals sometimes are not attainable and are better abandoned. We have long argued that sufficient doubt about goal attainment yields a tendency to disengage from efforts to reach the goal, and even to disengage from the goal itself (Carver & Scheier, 1981, 1998, 1999a, 1999b). This is certainly a kind of priority adjustment, in that the abandoned goal now receives an even lower priority than it had before. No behavior at all is being directed to its attainment.

At first glance, the idea that doubt about goal attainment (and the associated negative affect) reduce effort seems to contradict Simon's (1967) idea that negative affect is a call for

higher priority. However, an important distinction between two approach-related negative affects elaborates on Simon's thinking (Carver, 2003, 2004; parallel reasoning applies to avoidance). Some negative affects pertaining to approach coalesce around frustration and anger. Others coalesce around sadness, depression, and dejection. The former relate to an increase in priority, the latter to a decrease.

Our view on affect places approach-related affects on a dimension, but a dimension with complex effects. Theory holds that falling behind—progress below the criterion—creates negative affect, as the incentive slips away. Inadequate movement forward (or no movement, or going backward) gives rise to frustration, irritation, and anger. These feelings (or the mechanism underlying them) engage effort more completely, to overcome obstacles and enhance current progress. If the situation is one in which more effort (or better effort) can improve progress, the person moves toward the incentive at an adequate rate, and attaining the incentive seems likely. This case fits the priority management model of Simon (1967).

Sometimes, however, continued efforts do not produce adequate movement forward. Indeed, if the situation involves loss, movement forward is precluded, because the incentive is gone. In a situation where failure seems (or is) assured, the feelings are sadness, depression, despondency, grief, and hopelessness (cf. Finlay-Jones & Brown, 1981). Accompanying behaviors also differ. The person tends to disengage from—give up on—further effort toward the incentive (Klinger, 1975; Lewis et al., 1992; Mikulincer, 1988; Wortman & Brehm, 1975).

As noted, negative feelings in these two kinds of situations parallel two divergent effects on action. Both effects have adaptive properties. In the first situation—when the person falls behind, but the goal is not seen as lost—feelings of frustration and anger accompany increase in effort, a struggle to gain the incentive despite setbacks. This struggle is adaptive (thus, the affect is adaptive) because the struggle fosters goal attainment.

In the second situation—when effort appears futile—feelings of sadness and depression

accompany *reduction* of effort. Sadness and despondency imply that things can not be set right, that effort is pointless. Reducing effort in this circumstance can also have adaptive functions (Carver & Scheier, 2003; Wrosch, Scheier, Carver, & Schulz, 2003; Wrosch, Scheier, Miller, Schulz, & Carver, 2003). It conserves energy rather than waste it in pursuit of the unattainable (Nesse, 2000). If reducing effort also helps diminish commitment to the goal (Klinger, 1975), it eventually readies the person to take up other incentives in place of this one.

<div align="center">Two Modes of Functioning?</div>

Earlier we distinguished between action sequences that seem to occur more or less all-at-a-piece, once begun, and programs that appear to require more decision making and planning. At that time, the boundary between the more automatic and the less automatic was noted simply as a matter of differences in level of abstraction of the action goal. Now we consider this boundary in a somewhat different way.

Top-Down and Bottom-Up Behavior Control

For the most part, we have written about action as though it was controlled from the top down: people form intentions and realize those intentions by making their perceptions of their actions match those intentions. There is evidence, however, that a good deal of behavior does not happen that way. Rather, it self-organizes. It falls into a pattern that was not planned or intended. Instead, a pattern emerges from the confluence of two or more other things going on at the same time (Brooks, 1999; Kelso, 1995; Newtson, 1993, 1994; Prigogene & Stengers, 1984). A common example of self-organization is that gaits naturally emerge in the locomotion of quadrupeds (Turvey, 1990). Another example is a familiar cue causing a person to go off-track and substitute another act for the act intended (Norman, 1981). Does this sort of evidence mean that behavior is not guided by intentions? No, but it means that a view addressing *only* intentions is incomplete.

Many people have by now argued that there are two distinct modes of functioning, with

distinct operating characteristics (for a review see Carver, 2005). Sometimes behavior is guided from the top down, and sometimes not. In personality psychology, Epstein has long advocated such an idea (Epstein, 1973, 1985, 1990, 1994). What Epstein calls the *rational* system operates mostly consciously, uses logical rules, is verbal and deliberative, and thus is fairly slow. The *experiential* system is intuitive and associative. It relies on salient information and uses short-cuts and heuristics. It functions automatically, nonverbally, and quickly, even impulsively.

A great many other people have since made arguments that resemble those in broad strokes. Perhaps the most widely noted two-mode model in social psychology is that of Strack and Deutsch (2004). What they called a reflective system anticipates future conditions, makes decisions from those anticipations, and forms intentions. It is planful and wide-ranging in its search for relevant information. It is restrained and deliberative. What they called an impulsive system acts spontaneously when its schemas or production systems are sufficiently activated. It acts without consideration for the future or for broader consequences of the action.

The idea that there are two modes of functioning also may fit with a burgeoning literature differentiating explicit from implicit motives, knowledge structures, and attitudes. Implicit measures tap associative links among elements. Explicit measures are symbolic, products of deliberative processing. Implicit knowledge presumably accrues through association learning; explicit knowledge presumably accrues through verbal, conceptual learning. This view of the information coming from these two kinds of measures is speculative, but would fit nicely with two-mode models of functioning.

Two-mode thinking has also been influential in developmental psychology. Rothbart and others (e.g., Derryberry & Rothbart, 1997; Rothbart, Ahadi, & Evans, 2000; Rothbart, Ellis, Rueda, & Posner, 2003; Rothbart & Posner, 1985; see also Kochanska & Knaack, 2003; Nigg, 2000) have argued for three temperament systems: approach, avoidance, and a third termed *effortful control*. The latter concerns attentional management and inhibitory control (the ability

to suppress an approach behavior when approach is situationally inappropriate). This model assumes that effortful control is superordinate to approach and avoidance temperaments (e.g., Ahadi & Rothbart, 1994). The label *effortful* conveys the sense that this is an executive, planful activity, entailing the use of cognitive resources beyond those needed to react impulsively. This view of effortful control has a great resemblance to depictions of the deliberative mode of the two-mode models outlined previously.

Hierarchicality Reexamined

All these sources promote the inference that a deliberative mode of functioning uses symbolic and sequential processing, and thus is relatively slow. All also suggest that a more impulsive mode of functioning uses associationist processing and is relatively fast. Many of the theories suggest that the two modes are semi-autonomous in their functioning, competing with each other to influence actions. Indeed, many have suggested situational effects that influence which mode dominates at a given time (e.g., cognitive load impairs the ability to be deliberative). Some sources implicate different brain regions in the two modes of functioning. Specifically, it is often said that the deliberative mode depends critically on prefrontal cortical areas, and the impulsive mode relies primarily on subcortical areas.

We cautiously suggest the possibility of a correspondence between these two modes of functioning and a distinction made earlier in the chapter concerning levels of abstraction in action control: specifically, the split between program control and sequence control. There are several parallels between the two sets of ideas. There is evidence that different brain areas manage effortful and automatic versions of the same behavior (Casey et al., 2002; Lieberman et al., 2002; Posner & DiGirolamo, 2000). This in itself hints that there may be an important boundary between action control that is deliberative and action sequences that are well-learned enough to be spontaneous once cued. Other evidence also supports the idea that intention-based and stimulus-based actions involve different process of action-initiation (Keller, Wascher, Prinz,

Waszak, Koch, & Rosenbaum, 2006).

There are also similarities in the qualities that are ascribed to the different groups of behaviors in the two sets of ideas. We said earlier that programs entail decisions. They seem to be managed top-down, using effortful processing. Planfulness, an element of programs, is also a typical characterization of behavior that is managed by a prefrontal cortical system. In contrast to this deliberative quality, well-learned sequences occur in a relatively automatic stream once triggered. Sequences may respond to triggering cues simply by virtue of associations in memory. Their characteristics seem more akin to those of the more basic mode of functioning.

On the other hand, there is also some evidence that does not easily fit a division based on level of abstraction. Specifically, relatively abstract goals (cooperation, performing well) that are operating out of awareness (and thus are relying on automatic functions) display several of the same operational characteristics as do consciously monitored (and thus deliberative) goals (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001). It is unclear to what extent the key issue is how well-learned the activity is, versus than how abstract or concrete is the goal.

In previous discussions (e.g., Carver & Scheier, 1998, 1999a) we often noted that the level of control that is functionally superordinate can vary with the situation (and across persons). That is, one can imagine cases in which a person is presently behaving according to a principle (e.g., a moral or ethical value), and cases in which the person is behaving according to a plan or program. One can also imagine cases in which the person is behaving impulsively and spontaneously, without regard to either principle or plan. In the past, our emphasis here was typically on how sequences and programs differed from each other.

Self-Control: Impulse and Restraint

The idea that there are spontaneous and planful goals, which can come into conflict with each other, is also part of the literature on self-control and self-control failure (Baumeister & Heatherton, 1996; Baumeister, Heatherton, & Tice, 1994). This literature focuses on cases in

which a person is both motivated to act and motivated to restrain that action (which also is the focus of work on children's effortful control). In some ways, the logical structure of the cases addressed in that literature resembles the logical structure of the delay of gratification paradigm. A difference is that in the cases in the self-control literature the intent often is to delay indefinitely rather than temporarily.

The literature on self-control failure tends to portray these cases as involving a relatively automatic tendency to act in one way, opposed by a planful and effortful tendency to restrain that act. The action that is being inhibited is often characterized as an impulse, a desire that would automatically be translated into action unless it is controlled (perhaps in part because this action is habitual, perhaps in part because it is more primal). The restraint is presumed to be effortful, and to depend on limited resources. If the planful part of the mind is able to attend to the conflict, the person may be able to resist the impulse. If not, the impulse is more likely to be expressed. This portrayal seems consonant with two-mode models of functioning (see also Carver, 2005).

Brain Function

Recent years have seen the emergence of a body of work given such labels as social and affective neuroscience. This work involves the blending of ideas from personality and social psychology with ideas and methods of brain science. Of particular interest are neuroimaging techniques that permit identification of brain regions that are particularly active or inactive during specific kinds of mental activity.

It seems likely that the sorts of issues raised in this section of the chapter will only increase the appeal of such research. Many of the theoretical models discussed in the latter part of the chapter argue for differential involvement in behavior of brain areas that reflects each mode of functioning. As more and more behavioral paradigms are brought into labs to determine patterns of brain activity, more will be revealed about what properties of the central nervous system

support what kinds of self-regulation.

There is also another biological literature that may similarly become important in the study of action control. This literature examines neurotransmitter functions and their relation to aspects of behavior that are relevant to the issues under discussion here. In particular, a good deal of evidence now implicates serotonin function in the behavioral dimension of impulse versus constraint (Carver & Miller, 2006). A substantial number of studies relate low serotonin function to impulsive aggression and impulsiveness more generally. There is also evidence linking both impulsivity and aggressiveness to poorer executive (frontal lobe) function (e.g., Dolan et al., 2002). The hypothesis that the impulsiveness that is associated with low serotonin function reflects poor frontal control is undergoing further scrutiny.

Many have had concerns that about the emerging blending of brain science with other aspects of psychology, fearing that psychological ideas may be lost in the shuffle. We believe the issues discussed in this part of the chapter make a case that the brain science will gain as much from the psychological science as the other way around. We trust that continuing conceptual developments in psychological science will continue to make that case even more forcefully.

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