

Two Distinct Bases of Inhibition of Behaviour: Viewing Biological Phenomena Through the Lens of Psychological Theory

CHARLES S. CARVER

University of Miami, FL, USA

Ccarver@miami.edu

Abstract

Constructs concerning reward and threat sensitivity can be organised in several ways (along with other ideas). Which conceptual organisation is used channels interpretations of phenomena ostensibly reflecting the sensitivities. For example, a two-mode organisation in which behavioural inhibition can follow either from threat sensitivity or from effortful control (planful restraint) yields an interpretation of serotonergic function quite different from what many assume. In this view, accumulated evidence suggests that serotonergic function relates to effortful control, rather than threat sensitivity. Neurobiological tools are useful, but their usefulness often depends on psychological theory. Copyright © 2008 John Wiley & Sons, Ltd.

The idea that approach and avoidance tendencies are building blocks of elaborate behaviour is prominent again in personality psychology, as is the idea that individual differences in responsiveness of systems for approach and avoidance underlie dimensions of personality. There are, however, several ways to use those ideas (in conjunction with other ideas). Smillie (this issue) described one organisation, following Gray and McNaughton (2000). I favour a somewhat different organisation, outlined later.

Smillie's main point is the desirability of using new techniques to determine true reward and threat sensitivities (as opposed to self-reported sensitivities).¹ Though the techniques outlined doubtlessly are useful, I offer a caution: Apart from behavioural paradigms, the techniques Smillie touted all require linking an observed biological phenomenon to an inferred psychological one. Unfortunately, there are many psychological third variables in that process. Focusing on a salient but noncritical psychological variable can induce errors in linking the biological to the psychological. These links easily become unquestioned assumptions.

Assumptions about the psychological meaning of biological data must be reexamined repeatedly. This cannot be done once and for all. Change in psychological model can suggest a change in meaning for the link from biological to psychological. I illustrate this below with a case in which I believe Smillie's discussion reflects a misinference. The psychological model displayed in Smillie's Figure 1 leads easily to the misinference. An alternative model, however, suggests a very different interpretation.

Impulsivity, anxiety and constraint. Consider three theoretical organisations involving approach and avoidance. Smillie's Figure 1 reflects Gray's (1981) initial theory proposing

¹It is a little ironic that Smillie expressed concern about the validity of inferences made from human self-reports, but seemed less concerned about building a theory of human personality by observing rats' behaviour and making inferences about their emotional states.

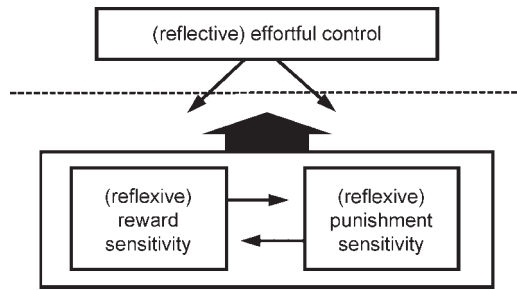


Figure 1. Three temperaments as influences on behaviour. Two reactive (reflexive) systems compete, as they become engaged by cues of reward and punishment, respectively. The resultant tendency is manifested directly in behaviour, if effortful control is low (due to disposition, developmental level, or situational influence). Effortful control (reflective) depends on executive processes. When these processes are engaged, they can countermand the resultant emerging from the basic systems, thus dampening the role of the basic systems. Adapted from discussions by Rothbart and others.

personality dimensions of reward sensitivity (impulsivity) and threat sensitivity (anxiety). Higher reward sensitivity leads a person to display more impulsive pursuit of rewards, given reward cues. Higher threat sensitivity leads greater inhibition, given cues of impending punishment. One clear implication of this view was that impulses are expressed unless they are inhibited by sufficient anxiety. Another was that anxiety is the main determinant of inhibition.

The theory was later revised in a rather profound way (Gray & McNaughton, 2000). The behavioural inhibition system (BIS), formerly the mechanism of threat sensitivity, now concerns conflict. Although Smillie's Figure 2 says the conflict must be approach versus avoidance, his footnote 1 contradicts that, saying that BIS is also engaged by two incompatible approach goals. This is a critical difference. If a conflict between two approach goals engages BIS, then BIS cannot reflect punishment sensitivity. This would seem to be an important theoretical change.

My current view of approach and avoidance, and of issues pertaining to constraint that are not handled adequately by approach and avoidance alone (Carver, 2005; Carver, Johnson, & Joormann, 2008; Carver & Miller, 2006), reflects the developmental theories of Rothbart, Eisenberg and colleagues (Eisenberg et al., 2004; Rothbart, Ahadi, & Evans, 2000; Rothbart & Posner, 1985; see also Caspi & Shiner, 2006). As shown in Figure 1, these theories posit basic approach and avoidance temperaments. However, they also posit the gradual emergence of a temperament of effortful control, which depends on developing prefrontal executive functions. Effortful control constrains behaviour so that gratification can be delayed, and long-term goals can be attained. It also helps people to do things they do not really feel like doing. Effortful control is the core of trait Conscientiousness (Figure 1).

Together, these temperaments yield a two-layered system of behaviour management (for broader review of two-mode models, see Carver, 2005; Carver et al., 2008). At the lower layer, approach and avoidance tendencies compete, as in Gray's earlier view. If incentives are present and anxiety is low, reward pursuit commences; if anxiety is high, behaviour is inhibited. When the superordinate level is in charge, however, both reactive tendencies (approach and avoidance) can be countermanded. Behaviour can be constrained for reasons other than cues of punishment, and behaviour can be emitted despite the absence of cues of immediate reward.

To my eye, the role of BIS in the revised RST (management of conflict) appears to resemble effortful control more than it resembles the avoidance temperament. If effortful control has bidirectional influence, however (promoting behaviour in the absence of immediate reward as well as inhibiting ill-considered impulses), this would not be strictly an 'inhibition' system.²

Serotonin function. I said earlier that different psychological models can promote different interpretations of biological phenomena. As an example, consider serotonin-related genes and serotonin function. It is common for discussions of serotonin function to refer to anxiety-related traits, punishment sensitivity or avoidance, but I believe those labels are misleading (Carver & Miller, 2006; Soubrié, 1986). Serotonin relates more broadly to constraint (Depue & Spoont, 1986; Spoont, 1992). Low serotonin function has been linked to aggression (often), anxiety (sometimes) and depression (often); serotonin has been linked to Agreeableness and Conscientiousness, as well as Neuroticism. Probably the most common correlate of serotonin function is impulsivity.

Why, then, so much focus on anxiety? One likely reason is the theoretical assumption that punishment sensitivity is what causes behavioural inhibition. As noted above, there is good reason to believe that self-control involves more than the balance of reward sensitivity to punishment sensitivity. However, this conclusion (which comes from developmental and other literatures) has not yet made its way to the literature on serotonin.

Here is a case where an emergent model suggests the need to reexamine assumptions about the psychological meaning of a biological phenomenon. With respect to anxiety in particular, two-mode models would suggest that anxiety and anxious behaviour have two co-determinants (*cf.* Depue & Lenzenweger, 2005). A sensitive threat temperament generates anxiety; a weak system of effortful control permits anxiety to spill into behaviour. The overt manifestations of anxiety would be dampened by either decreased sensitivity of the avoidance temperament or increased capacity for effortful control. Thus, there are two possible reasons why increased serotonin function reduces anxiety. I believe, however, that a close examination of the literature bearing on serotonin function suggests that the role of serotonin, here and elsewhere, concerns effortful control (Carver & Miller, 2006; Carver et al., 2008; Spoont, 1992).

More generally, although new physiological techniques provide great opportunities, biological phenomena do not completely dictate interpretation. The biological phenomena must be interpreted through the lens of psychological theory. As psychological theories evolve, new understandings of the biological phenomena may also emerge. The interdependence of psychological and biological runs both ways.

²Other labelling problems also plague RST. Gray labelled the core traits impulsivity and anxiety. But impulsivity reflects lack of executive control as much as or more than sensitivity to incentives. There are also divergent views of what 'anxiety' is; current RST treats it as the state that follows from conflict, even approach–approach conflict, thereby apparently disconnecting it from punishment or threat sensitivity.