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## Reinforcement Sensitivity Theory

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### Synonyms

[Reinforcer sensitivity theory](#); [Three-factor theory](#)

### Definition

The *reinforcement sensitivity theory* (RST) is a major neuropsychological account of emotion, motivation, and learning (Corr 2008). It proposes three principal systems: one, concerned with positive incentive, the behavioral approach system (BAS), and two defensive systems, one concerned with pure avoidance/escape, the fight-flight-freeze system (FFFS, related to fear), and second related to goal-conflict detection, the behavioral inhibition system (BIS, related to anxiety). Individual differences in these three systems are said to comprise the foundations of personality, and these individual differences have been shown to be related to a wide range of behaviors, including clinical (e.g., anxiety and depression) as well as everyday (e.g., work performance) ones.

## Introduction

The *reinforcement sensitivity theory* (RST) contains three major neuropsychological systems which underlie fundamental *states* of emotion, motivation, and learning relating to approach, avoidance, and conflict detection/resolution. Extensive work with (nonhuman) experimental animals has delineated the neurophysiological and neurochemical bases of these systems. In their longer-term *trait* instantiation, these systems are assumed to be reflected in the major dimensions of personality and, by extension, clinical disorder (for a survey of the entire field, see Corr 2008).

RST has its origins in the 1960s/1970s work of Jeffrey Gray, which in turn has deeper roots in a series of groundbreaking work that may be traced back to Ivan Pavlov, who is well known for his work on the “types of the higher nervous system” – lesser known is Pavlov’s work on personality and psychopathology. Pavlov’s research was seminal in attempting to provide a mechanistic account of the mind/soul that, hitherto, was confined to the recondite ratiocination of philosophy. Pavlov inspired generations of scientists with his views on the nature of the mind, as well as his scientific hope that it could be understood within an experimental methodological framework of the kind found in the behavioral laboratory. Pavlov’s influence was transmitted to Jeffrey Gray through his mentor Hans Eysenck.

## RST of Personality

The central assumption of RST is that the variation observed in the functioning of the principal brain-behavioral systems, underlying approach, avoidance, and conflict, comprises what we mean by “personality” – of course, there is more to personality traits than can be explained by these basic systems alone, but they are considered foundational upon which all else depends. This assumption is based on the notion of three major behavioral degrees of freedom (approach and avoidance, and the conflict between them). Seen in this way, personality does not stand apart from fundamental brain-behavioral systems: it is defined and characterized by them. Important in all of this is the claim that there is an essential phylogenetic continuity, which includes the human species – therefore, it makes scientific sense to talk of the personality of other animals (and this is now routinely done).

As a result of this early work, and increasingly strengthened by empirical advances afforded by ever more sophisticated technology, today we have a viable and vibrant “neuroscience of personality” (something of an oxymoron not too many years ago). As evidence of this development, in 2017, Cambridge University Press launched a new journal, *Personality Neuroscience*, edited by the present author.

Much of the interest in RST originated from Gray’s (1982) highly influential book, *The Neuropsychology of Anxiety*. This book offered a detailed account of the “conceptual” (behavioral) and “central” (real) nervous systems of a “behavioral inhibition system” (BIS) which Gray proposed as the neuropsychological substrate for (both normal and abnormal) anxiety – more precisely, the BIS is the substrate for the behavioral, attentional, and cognitive processes that interact with other processes responsible for the generation of the *experience* (qualia) of anxiety (i.e., it is possible to be BIS active without being anxious; see Corr and McNaughton 2015). BIS theory was based on a detailed examination of the behavioral (rodent) profile of the effects of various (human) antianxiety drugs. In 2000, with Neil McNaughton,

Gray updated the 1982 book. Along with the BIS, two other neuropsychological systems gradually gained prominence.

## RST Systems

Present-day RST postulates three major systems of motivation, emotion, and learning (for a discussion of the development of these systems, see Corr 2008).

1. The *fight-flight-freeze system* (FFFS) is responsible for mediating reactions (principally, active avoidance and escape behaviors) to *all* aversive stimuli, conditioned and unconditioned. The FFFS mediates the “get me out of this place” emotion of fear, but *not* anxiety. Related personality factors include fear-proneness and avoidance, and these can be conceptually mapped to such internalizing disorders as specific fears and phobia.
2. The *behavioral approach system* (BAS) is responsible for mediating reactions (principally, exploration of and approach) to *all* appetitive stimuli, conditioned and unconditioned. It generates the emotion of “anticipatory pleasure” and, more generally, the state of “hope” – its motto is “Let’s go for it!” Related personality factors include optimism, reward orientation, and impulsiveness, which can be mapped onto such externalizing clinical disorders as substance abuse, pathological gambling, and various disinhibitory behaviors.
3. The *behavioral inhibition system* (BIS) has undergone the most significant change post-2000. It is now said to be responsible for the detection of goal conflict (this is not restricted to FFFS-BAS conflict) and not, as before, mediating reactions only to *conditioned* aversive stimuli (as well as a special class of innate fear stimuli). The BIS is the “Watch out for danger” system. Its principal behaviors are passive avoidance and withholding entrance to a dangerous place. Upon activation, the BIS entails the inhibition of prepotent conflicting (FFFS and BAS) behaviors, the engagement of risk assessment processes, and

the scanning of memory and the environment to help resolve concurrent goal conflict. The BIS resolves conflicts by increasing, by recursive loops, the negative valence of stimuli (these are adequate inputs into the FFFS), until behavioral resolution occurs in favor of approach or avoidance. During this process, the state is experienced subjectively as worry and rumination. Related personality factors include worry-proneness and anxious rumination, and it results in constantly being on the lookout for signs of danger. BIS outputs can be mapped onto clinical conditions which include generalized anxiety and obsessional-compulsive disorder (OCD).

### Clarifying FFFS and BIS

Revised (post-2000) RST emphasizes in much clearer form the categorical distinction between the FFFS and BIS, and this has been seen to hold important implications for understanding the continuities and discontinuities of clinical disorder. As summarized by Gray and McNaughton (2000; see, also, Corr and McNaughton 2012, 2015), there is now extensive experimental animal evidence for the functional and neuropsychopharmacological differentiation of these two systems of defense. In human studies, this distinction is supported by behavioral genetics of major psychiatric disorders, as well as structural equation modeling of symptoms, both of which agree that there are two major clusters: internalizing (FFFS/BIS) and externalizing (BAS). In relation to the internalizing cluster, this further breaks down into “fear” (FFFS) and “anxious misery” (BIS). In human personality studies, the same separation is also found. For example, psychometric measures of fear and anxiety are differentiated in confirmatory factor analysis; predictive validity studies point to the different functions of the FFFS and BIS; and it is possible to identify different facial expressions for FFFS-related fear and BIS-related anxiety (see Perkins et al. 2012).

### Empirical Studies

In human personality studies, various RST questionnaires have been developed (for a summary, see Corr 2016). The most comprehensive is the Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ; Corr and Cooper 2016), which contains separate measures for the FFFS and BIS and four scales for the BAS: Reward Interest, Goal-Drive Persistence, Reward Reactivity, and Impulsivity (these four factors are modeled on the subgoal scaffolding theory of the BAS) – in addition, the RST-PQ has a defensive fight factor because the research literature shows clearly that, in the specific case of questionnaires, this defensive factor correlates more with the BAS, not the FFFS (although in high-intensity situations, *behavioral* defensive fight is still thought to be associated with the FFFS).

Much research is underway to understand better how individual differences in these systems (as measured by questionnaire) relate to a wide range of phenotypes. What RST offers is a way to start exploring the more fundamental psychological roots of these phenotypes. For example, they help to explain the relationship between handedness and negative affectivity (Beaton et al. 2016). Whereas previous research associated being left handed with anxiety, it was never clear whether this was related preferentially to the FFFS or the BIS. Recent work shows that left-handedness is related to the BIS and is unrelated to the FFFS (which, if anything, is related to the *extent* of right-handedness). Other research shows theoretically interesting relations with the FFFS, BIS, and BAS (e.g., emotional intelligence, procrastination, and perfectionism). RST can also be extended to explaining the underlying psychological dynamics in everyday behavior, for example, in the workplace.

Much of this RST work suggests, as indeed do human laboratory studies, that the *interplay* of the FFFS, BAS, and BIS needs to be considered – this is important because the activation of one system can modify the operation of the other systems. The functional independence (dubbed the “separable subsystems hypothesis”) and functional interdependence (dubbed the “joint subsystems

hypothesis”) have received empirical attention, and the extant evidence indicates that these systems often work together to influence the net product of behavior (see Corr 2013). In addition, increasingly, molecular genetics and functional neuroimaging studies are beginning to throw light on the brain circuits substantiating the FFFS, BIS, and BAS (for a review of this literature, see McNaughton et al. 2016).

## Conclusion

Much work is still needed to develop the basic tenets of RST, and to extend what is known, especially to clinical psychology, but also to other areas of everyday life (e.g., work motivation). There is also much potential to account for developmental trajectories, as well as epidemiological outcomes of the trait dispositions of the FFFS, BIS, and BAS. The intersection of illness, health, and well-being is especially important. The fact that we now have a recognized *neuroscience of personality* owes much to the type of theory epitomized by RST.

## Cross-References

► [Sub-goal Scaffolding](#)

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