

Focus Article Online Exclusive

The Behavioral Activation and Inhibition Systems: Implications for Understanding and Treating Chronic Pain

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Abstract: Evidence from a number of sources supports the existence of two relatively independent neurophysiological systems that underlie avoidance- and approach-related emotions, cognitions, and behavior. There is considerable overlap between 1) the emotions, cognitions, and behaviors controlled by these two systems, and 2) the known effects of chronic pain. Here we propose a 2-factor model of chronic pain on the basis of these well established 2-factor models, and discuss the implications of the model for understanding the effects of pain and mechanisms of psychological pain treatments. The model makes specific hypotheses, which are unique to the proposed model, regarding the mechanisms underlying pain's negative influence and the benefits of psychological pain treatments. The model also provides an overarching framework that could enhance outcomes by 1) broadening the assessment of factors that may be influencing pain and its effect on individual patients, and 2) suggesting that specific techniques from different treatments may be combined to better target these factors.

Perspective: The 2-factor model presented in this report provides a framework for understanding the effects of psychological pain treatments, and makes specific a priori hypotheses regarding the specific mechanisms of those treatments. Clinical applications of the model have the potential for enhancing treatment outcomes.

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One of the most significant problems resulting from chronic pain—if not the most significant problem—is its negative effect on psychological and physical functioning. The presence and the severity of chronic pain are associated with depression,^{47,106} anxiety,^{5,71} and physical disability.⁶⁴ Pain often interrupts behavior^{34,44} and hinders progress toward valued goals.^{1,33} For some individuals, efforts to manage pain and its effect become the central focus of their lives,

severely limiting the time and energy available to engage in meaningful activities. As a consequence, chronic pain results in a marked decrease in the overall quality of life for many individuals.⁶⁴ To develop the most efficacious treatments for helping people better manage pain's effect on function and quality of life, it is important to understand the processes that underlie pain's influence on valued, goal-directed behavior.

Over the past several decades, a number of models of behavior, motivation, and emotion have been proposed that hypothesize the existence of 2 distinct neurophysiological systems: one system underlying “approach behaviors” and a second system underlying “avoidance behaviors.”^{24,32,36,40,50-52,57,80,81,134,135} Although these are not the only neurophysiological systems that control or underlie all human behavior, they are hypothesized to play an important role in influencing

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many of our emotional, cognitive, and behavioral responses to environmental and sensory cues; in particular, our decision(s) to inhibit behavior or to remain active. This article explores how a 2-factor neurophysiological model of approach and avoidance behavior may 1) help us understand the effect of chronic pain on physical and psychological dysfunction, and 2) explain how theoretically diverse psychosocial pain interventions have their beneficial effects.

The article is organized into 6 sections. In the first section, we present basic background information about, and briefly summarize the empirical support for, the 2-factor neurophysiological models of approach and avoidance behavior. Next, we propose and describe the key features of a 2-factor model of chronic pain that incorporates the basic tenets of these models. In the third section, we discuss how the proposed model may help us understand currently unresolved questions concerning 1) the effect of pain on activity, 2) the purpose and automaticity of pain-related catastrophizing, and 3) the mechanisms of different psychosocial pain treatments. In the fourth section, we describe a number of key testable hypotheses derived from the model. We then discuss the potential benefits of an overarching model of psychosocial pain treatment, such as the one proposed. In the sixth and final section, we discuss some of the limitations of the model and suggest directions for research to test and develop it further.

Two-Factor Models of Behavioral Regulation, Motivation, and Emotion

A number of models and theories propose the existence of 2 distinct neurophysiological systems that underlie behavioral regulation, motivation, and emotion.^{24,32,36,40,50-52,54,57,80,81,134,135} These models were developed by different research groups using various methodological approaches, such as factor analyses of measures of emotions^{134,135} and observation of the effects of chemicals on animal behavior.⁵² Although different in their methodological approaches, the scientists who developed these models independently came to the same general conclusion: there are 2 key neurophysiological systems that underlie many of the core elements of day-to-day human behavior and experience. The first is an approach system responsible for approach behaviors, associated emotions (eg, hope, joy, excitement, anger), and cognitive content (eg, self-efficacy). The second is an avoidance system responsible for behavioral withdrawal, associated emotions (eg, anxiety, depression), and cognitive content (eg, threat attributions, hopelessness). These 2 systems share similar cognitive processes—that is, they are both influenced primarily by associative and experiential learning. They are also “automatic” in that they operate separately from executive control. Moreover, a key principal of these models is that the 2 subsystems are relatively independent, in much the same way that an acceleration system (controlled by the gas pedal)

and a braking system (controlled by the brake pedal) independently influence the speed of an automobile. We discuss research supporting this independency later in this section.

Probably the most often cited of the numerous 2-factor approach-avoidance models is Jeffrey Gray's reinforcement sensitivity theory.^{50-52,54} This model hypothesizes that the approach and avoidance systems are activated when there are environmental cues that signal the possibility of reward or punishment, respectively. According to Gray's model, in the presence of cues that the organism has learned to associate with reward, a behavioral approach system (BAS; also referred to as a behavioral activation system⁴¹) is activated, which then facilitates and encourages approach-related behaviors, cognitions, and emotions.

What is rewarding, of course, varies from person to person, and depends on the individual's physiological state (eg, Is the individual hungry or fatigued?), values (eg, the relative importance to the individual of specific activities, such as paid employment, contributing to a household, or socializing with friends), as well as the specific goal(s) that the individual is focusing on at any one point in time (eg, higher-level goals of “being a good person” vs somewhat lower-level goals such as “being on time” vs the lowest-level goals representing specific behaviors such as eating).¹⁸ As the individual becomes aware of a discrepancy between a goal (eg, to eat food) and one's current state (eg, being hungry and currently not eating), the BAS becomes activated. When the BAS is activated, the BAS-related cognitions, emotions, and behaviors all work together to increase the likelihood that the potential reinforcement will actually occur.⁵⁰

When one goal is achieved (eg, being hungry and then eating a satisfying, reinforcing meal), an individual would then begin to behave in ways that address another goal. This next goal would be a BAS-related goal if there are environmental cues that signal the possibility of additional rewards. Which goal one selects is determined by an interaction between the cue(s) focused on, evaluation of the importance of the potential rewards that the cues signal (value), and expectations that the reward will occur.³⁸ BAS activation that facilitates access to the reward continues until 1) the discrepancy between one's current state and the goal to experience the reward is reduced or eliminated (which is hypothesized to be associated with positive affect¹⁸), 2) another discrepancy becomes more salient (eg, a cue suggesting the possibility of a new and more valued reward presents itself), or 3) attention is shifted to the possibility of punishment (by the emergence of a cue signaling this possibility), which interrupts the process and activates the behavioral inhibition system (BIS; see next paragraph). Thus, BIS and BAS activation, and the behaviors, thoughts, and feelings that follow, is a dynamic, multifaceted process.^{16,17}

In contrast, a separate BIS is hypothesized to become activated in the presence of cues indicating the

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