



Review

Cardiac defense: From attention to action[☆]Jaime Vila^{*}, Pedro Guerra, Miguel Ángel Muñoz, Cynthia Vico, Maria Isabel Viedma-del Jesús, Luís Carlos Delgado, Pandelis Perakakis, Elisabeth Kley, José Luís Mata, Sonia Rodríguez

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Abstract

The concept of defense relates to the idea that organisms react physiologically to the presence of danger or threat in order to protect themselves from potential injury or death. This article reviews the literature on cardiac defense, a specific defense reaction that has a long tradition in psychophysiological research. The review begins with a brief analysis of the two traditional approaches to understand this autonomic response: the cognitive – linked to Pavlov, Sokolov, and Graham’s work on sensory reflexes – and the motivational — linked to Cannon and Selye’s work on the concepts of activation and stress. Then, the classic model of cardiac defense and its basic assumptions concerning differentiation from other cardiac reflexes – namely orienting and startle – are presented. A critical analysis of these assumptions follows centered on evidence from a systematic research of the cardiac response to intense acoustic stimulation. Finally, an integrative model of cardiac defense is presented which emphasizes the dynamic nature of this defense reaction – characterized by a complex pattern of heart rate changes with accelerative and decelerative components, with sympathetic and parasympathetic influences, and with both attentional and motivational significance – providing a new framework in which the two opposite traditional approaches can be reconciled.

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1. Introduction

Organisms react physiologically to the presence of danger or threat in order to protect themselves from potential injury or death. Typical defense responses reported in the experimental and clinical literature include freezing, startle, fainting, and the fight–flight response. These various responses can be categorized into two general forms of defense (Lang et al., 2000): immobility and active defense. The protective function of both types of reactions is evident. However, if too intense or prolonged, this defensive reactivity may constitute a serious risk for both mental and physical health. For many researchers and clinicians, excessive physiological reactivity is the main mech-

anism linking defense to stress and illness (Dienstbier, 1989; Lovallo and Gerin, 2003; Turner, 1994).

Fear and anxiety are the typical emotional reactions to the presence of danger and threat and are, therefore, closely linked to the concept of defense. Recent advances in the neurophysiology of fear and anxiety come primarily from research with animals using defense reactions such as freezing, startle, and escape-attack behaviors (Davis, 1992; LeDoux, 2000; Blanchard and Blanchard, 1989; Fanselow, 1994). Paradigms frequently used to study the neural circuit of fear (fear conditioning, fear sensitization, and fear potentiation) always include nociceptive or intense stimulation, eliciting unconditioned defense reactions, in order to investigate the neural pathways underlying the fear response. Research with humans has also made frequent use of intense or aversive stimulation in order to study fear modulation of specific protective reflexes such as eye-blink startle or postural freezing (Lang et al., 2000; Azevedo et al., 2005; Ruiz-Padial and Vila, 2007).

Pathological fear and anxiety are also closely related to defense. Perhaps, the most dramatic evidence of the relevance of defense in the development of pathological fear and anxiety

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