How motivation affects cardiovascular response. Mechanisms and applications

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How Motivation Affects Cardiovascular Response

Mechanisms and Applications

Edited by
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This book is a product of discussions between the editors that began a number of years back. When the discussions began, we both were highly involved in motivationally based cardiovascular research and knew of many others who were as well. However, we were struck by how relatively isolated different motivationally based research programs were, chiefly because they tended to be carried out in different scientific quarters (e.g., neuroscience vs. ergonomics). The relative isolation was problematic for a variety of reasons. Most notably, it interfered with communication among laboratories and the appreciation of common theoretical themes and points of disagreement. It also masked the level of motivationally based research activity and made it difficult for outsiders to see the utility of a motivational approach. One way to counter this kind of isolation is to bring together a sampling of relevant investigators under a single literary “roof.” Thus, this is what we set out to do. The process of selecting contributors, securing commitments from them, and then actually getting chapters from them was not abbreviated. It also was not always simple. Most book editors will confirm that working with independent-minded academics can be a bit like herding cats. But we have no complaints. We were fortunate to obtain chapters from a truly stellar group of investigators.
INTRODUCTION

REX A. WRIGHT AND GUIDO H. E. GENDOLLA

The field of motivation is concerned with action—its selection, preparation, and execution. Put differently, it is concerned with why organisms move in the directions they do and why they do so with different degrees of persistence and vigor (McClelland, 1985). Outside of classic behaviorism (e.g., Hull, 1943), traditional conceptions of motivation (e.g., Lewin, 1935) have assumed that motivation has subjective feeling components that prompt individuals to act. Thus, for example, hungry people seek food because they experience an increased desire for it. Similarly, they seek to escape danger because they experience a “push” of fear. Because motivation is generally believed to have crucial feeling components, its formal study can be viewed as a part of the broader study of affective science.

Interest in motivational processes has waxed and waned across the history of psychology (for early theories, see Ach, 1935; Freud, 1966; James, 1884; Lewin, 1935). It waned especially during a period running from the mid 1960s through the 1980s due chiefly to the rise and temporary dominance of cognitive science. However, in the decade that followed, the interest regained force, being seen most often in discussions of effort, emotion, goals, and desire (Brehm, 1999; Brehm & Self, 1989; Carver & Scheier, 1998; Damasio, 1994;Deci & Ryan, 1985; Frijda, 1986; H. Heckhausen & Gollwitzer, 1987; Kuhl
& Beckmann, 1994; LeDoux, 1996; Locke & Latham, 1990). Interest in motivational processes continued to grow in the new millennium, and the field of motivation is currently among the most active areas of scientific study.

The level of contemporary interest in motivation is indicated in part by the veritable flood of books dealing with motivation that have appeared recently (Brewer & Hewstone, 2004; Deci & Ryan, 2002; Dweck, 1986; Elliot & Dweck, 2000; Forsgård, Williams, & Latham, 2005; J. Heckhausen & H. Heckhausen, 2010; Higgins & Kruglanski, 2000; Morsella, Bargh, & Goldwitzer, 2009; Moskowitz & Grant, 2009; Ryan, 2011; Sander & Scheier, 2009; Shah & Gardner, 2008). It also is indicated by recent developments in the psychology research community. Included among these are (a) the revitalization of the journal Motivation and Emotion; (b) the emergence of new dedicated motivation research outlets, such as the motivation section of the journal Social and Personality Psychology Compass; (c) the formation of motivation research centers at major universities, such as Columbia University (Motivation Science Center) and the University of Geneva (Swiss Center for Affective Sciences); and (d) the establishment of the Society for the Study of Motivation, which held its first conference in May 2008. The establishment of the Society for the Study of Motivation is especially noteworthy. Properly guided, it should increase the visibility of motivation as a subspecialty of psychology, improve the already active exchange of motivation ideas, and promote the development of motivation research and training programs at universities around the world.

It is in this context of heightened interest in motivation that we offer the present edited volume concerned with motivation influence on cardiovascular (CV) response, that is, adjustment in CV function. The volume is made up of chapters prepared by emerging as well as established research scientists and is international, including contributions from Belgium, Germany, the Netherlands, Switzerland, the United Kingdom, and the United States. Its central purposes are multifold. One is to increase awareness of the amount and diversity of motivationally based CV response research that is currently being conducted. Much of this work is being carried out in distinct quarters ("silos") of psychological science, such as those concerned with neuroscience, psychophysiology, social processes, and health. As a result, many scholars, investigators, and practitioners may be unaware of its extent and character. A second purpose is to facilitate relevant cross-disciplinary communication as well as comparison and contrast of guiding theoretical propositions and assumptions. Because scholars, investigators, and practitioners tend to work in distinct professional quarters, they tend not to communicate as much as they should with the broader range of their peers. This lack of communication works against the identification of crosscutting themes, complementarities, and points of conflict but can be countered by endeavors such as the present one to draw members of disparate groups together. A third purpose of the volume is practical—specifically, to illustrate how useful motivational approaches can be in informing us about CV responses in social, work, and achievement circumstances and highlighting conditions under which they might have implications for health.

**INTRODUCTION**

Research scientists who take a motivational approach to understanding CV response are ones who think in terms of goal pursuit, considering the roles of motivational variables such as effort, needs, and rewards. Although psychologists have long suspected linkages between motivational variables and CV responses (Cannon, 1927, 1929; Duffy, 1951), formal study of these linkages was limited for many years. An early research pioneer was Albert Ax (1953), who explored the possibility that anger (associated with motive to attack) had different CV correlates than fear (associated with motive to escape). Later pioneers included John and Beatrice Lacey (e.g., Lacey, Kagan, Lacey, & Moss, 1963) and Rogers Elliott (1965, 1969, 1972). The Lacey's made the case that phasic (very-short-term) heart rate (HR) responses decrease when people work to absorb environmental stimuli and increase when people work to shut out such stimuli. This perspective was motivational because—like the Ax perspective—it tied CV adjustment to the character of goal pursuit, specifically, the aims to take in and reject. Elliott (e.g., 1972) took issue with the Lacey view, proposing instead that HR is controlled by the instigation, anticipation, and initiation of behavioral responses and the presence of incentives. Elliott's incentive perspective was elaborated a decade later by Don Fowles (e.g., Fowles, Fisher, & Tranel, 1982; Tranel, Fisher, & Fowles, 1982), who concluded that HR varies in direct proportion to the magnitude (value) of performance incentives (see also Fowles, 1980, 1982).

Among the most influential motivational voices of the 20th century was that of Paul Obst. Like Elliott, Obst had difficulty with the Lacey "intake versus rejection" proposal. His early research explored the possibility that HR findings cited in support of the proposal in fact reflected cardiac-somatic coupling, that is, decreased motor activity during the performance of "intake" tasks and increased motor activity during performance of "rejection" tasks (Obst, 1968). The research was predicated on two ideas that seem obvious in retrospect but went largely against the intellectual grain in psychology at the time. One was that the CV system is a biological system that functions chiefly to perfuse tissue in proportion to its need. The other was that perfusion requirements vary with the level of behavior. These ideas were fresh because most people investigating CV correlates of motivational variables assumed, at least implicitly, that the
variables generated CV outcomes directly. Psychologists also tended to think little about metabolism in accounting for CV adjustments.

Later studies investigated when CV responses may become somatically uncoupled, that is, dissociated from movement (Obrist et al., 1978; Obrist, Webb, Sutterer, & Howard, 1970). Obrist's interest in cardiac–somatic uncoupling led in time to what currently is considered his most significant scientific contribution: his reasoning regarding active and passive coping (Obrist, 1976, 1981). Obrist proposed that active coping involves effortful action on the environment, whereas passive coping involves docile endurance of some environmental condition. He proposed further that the two types of coping are associated with distinct CV outcomes and possibly distinct health outcomes. Specifically, active (i.e., effortful) coping leads to beta-adrenergic sympathetic stimulation of the heart and potentially pathological tissue overperfusion, that is, perfusion in excess of that which is required metabolically. Passive coping, by contrast, leads to alpha-adrenergic stimulation of the vasculature and tissue perfusion scaled to metabolic requirements. Obrist's thoughts regarding active and passive coping have had a profound impact on CV psychophysiology. Many of the research programs discussed in this volume, including those in our own laboratories, can be traced back to them.

A special comment might be made about a friend and colleague of Obrist's, Jasper Brener. Drawing both on theory about the mobilization and expenditure of energy (Duffy, 1951; Germana, 1972) and on Obrist's ideas pertaining to active coping, Brener proffered a number of hypotheses concerning the conditions under which tissues will become overperfused. A construct of central focus was behavioral uncertainty. Brener (e.g., 1987) observed that energy consumption (i.e., metabolic activity) and CV responses commonly fall across experimental trial periods even though performance outcomes improve over the periods. By way of explanation, he suggested that energy mobilization is positively correspondent to behavioral uncertainty, whereas performance tends to improve as behavioral uncertainty is reduced. Brener reasoned that it is functional for metabolic rates to be elevated under conditions of behavioral uncertainty because organisms need to be prepared to carry out the most difficult behavior that may be required. Once some lesser action is required, a reduced metabolic rate can follow. An implication is that tissue overperfusion may be especially likely where behavioral uncertainty is high.

ORGANIZATION OF THIS BOOK

Motivation perspectives in this volume draw from and build on past views. They vary in multiple respects, including level of analysis, assumptions regarding mediating mechanisms, and emphasis on process versus application.

Because of this, they do not lend themselves to easy organization. However, they are sufficiently thematic to have allowed us to break the volume into two major parts—mechanisms and applications—with distinctive subsections.

Part I: Mechanisms

Part I includes chapters that address relationships between motivational variables and CV outcomes, sometimes assuming direct links and at other times assuming indirect mediation. Where indirect mediation is assumed, it most frequently is tied to effort. The first subsection begins with a chapter by Gray and Mischley (Chapter 1) that discusses neural integrative processes that underlie CV adjustments in performance contexts. It continues with two chapters concerned with effort as a direct CV response determinant. The first, by Kelsey (Chapter 2), follows strongly in the Obrist tradition by addressing cardiac pre-ejection period as an index of effort-related beta-adrenergic adjustment. The second, by Fairclough and Mulder (Chapter 3), follows in the Obrist tradition as well but takes a broader psychophysiological perspective and considers in greater detail underlying effort processes.

The second subsection offers new discussions pertaining to reward influence on CV response and the possibility that CV response patterns may be motive specific. Richter (Chapter 4) considers past and present reward ideas and evidence relevant to them, attending especially to the possibility that reward effects might be by-products of effort, that is, present only insofar as reward affects the degree to which performers become task-engaged. Kreibig (Chapter 5) examines motivation influence in light of a contemporary analysis that holds that emotions are associated with distinct autonomic activation patterns. As noted previously, emotions can be conceptualized as motivational states, that is, states in which people are impelled to pursue particular goals. Thus, the implication is that different motives may be associated with different autonomic themes that presumably have functional utility.

The third subsection of Part I focuses on affect and stress associated with motivational conflict. Miron and Brehm (Chapter 6) discuss possible CV implications of a theory of emotion to which Brehm devoted the bulk of his professional attention during the last decade of his life. The theory links emotion intensity to factors that oppose emotions and the behaviors they promote. In doing so, it presents the possibility that the same "deterrence" factors may affect CV responses in complex, but identifiable ways. Gendolla, Brinkmann, and Silvestrini (Chapter 7) consider mood and depression influence on CV response. Taking the perspective of Gendolla's mood–behavior model (Gendolla, 2000), they conclude that mood and depression effects are multifaceted and mediated by their impact on people's evaluations of task demand and the value of success. Stanley and Contrada (Chapter 8) observe
that people can experience opposing inclinations, orientations, and presses in action circumstances and review theory and research that links that experience to CV responsivity.

Part I concludes with a subsection concerned with fatigue, defined as depletion of a replenishable resource within a performance system. The first fatigue chapter, by Segerstrom, Hardy, Evans, and Winters (Chapter 9), addresses self-regulatory fatigue, that is, depletion generated by effortless control of thoughts, actions, and emotions. Based largely on neural process reasoning relevant to that discussed by Gray and Critchley, it links self-regulatory strength and the self-regulatory process to parasympathetically mediated cardiac adjustments. The second chapter in this subsection, by Wright and Stewart (Chapter 10), addresses fatigue more generally, making the case that fatigue CV influence might best be understood in terms of fatigue's impact on task difficulty appraisals and the effort effects that flow from them.

**Part II: Applications**

Part II includes chapters that involve application, with focuses on health and goal pursuit in different life circumstances. Those in the first subsection address the common assumption that CV responses mark or cause CV disease development. Bongard, al'Abi, and Lovallo (Chapter 11) discuss evidence relevant to the assumption, considering in the process the roles of motivational variables such as effort and task difficulty. Carroll, Phillips, and Lovallo (Chapter 12) take a contrarian view, arguing that blunted CV reactions associated with motivational variables might sometimes yield negative health outcomes.

The second subsection is concerned with social motives. Ewart (Chapter 13) starts with a discussion of his work on CV correlates of two types of striving, one oriented toward controlling others (agonistic) and the other oriented toward controlling oneself (transcendence), making the case that the former type of striving may be associated with greater health risk. Smith, Caccioppo, and Uchino (Chapter 14) follow with a chapter that pursues a related theme. Their chapter explores broadly the control or agency dimension of social behavior, considering CV and health consequences of a range of agentic strivings, such as those to acquire status and influence others. Norman, DeVries, Hawley, Torrance, and DeHart (Chapter 15) discuss social interaction influence on social strivings and their associated psychophysiological responses, including CV responses. Larsen and Christenfeld (Chapter 16) consider CV effects of social stress, attending especially to social situations in which goals are ambiguous and associated with no clear measures of success (indeterminate). The subsection closes with a chapter concerned with sex differences in CV response. Wright and Barreto (Chapter 17) contend that progress can be made in understanding these and health outcomes that may follow from them by considering sex influence on critical motivational variables such as appraisals of goal value and the impact that these variables have on effort.

The third subsection of Part II is concerned with work behavior and achievement. Backs, Lenneman, and Cassavaugh (Chapter 18) review human factors and ergonomics research concerned with CV responses in work settings, attending especially to the use of CV outcomes as indices of mental workload—a construct with obvious motivational implications. Capa (Chapter 19) takes a fresh look at achievement motivation, deriving some new effort hypotheses and arguing for the use of CV measures in the assessment of achievement striving.

**AN OVERARCHING FRAMEWORK**

Although the perspectives represented in this volume are diverse, a sizable portion of them use in some fashion a conceptual analysis that has long guided work in our laboratories (Gendolla, Wright, & Richter, in press; Wright, 1996). Many others address variables related to the analysis and discuss evidence that comport with it. These considerations hold out the possibility that the analysis might provide an overarching framework from which general lessons about motivation influence might be derived. With this possibility in mind, we end our introduction by outlining some elements of this conceptual analysis and identifying potential lessons that we see and consider to be important. Readers will find additional depictions of the analysis in later chapters and can access elaborations with full literature reviews elsewhere (e.g., Gendolla et al., in press). We include a description here to encourage readers to consider the lessons from the first chapter forward.

**Core Components, Assumptions, and Suggestions**

As has been noted in many previous publications (e.g., Wright, 1996, 1998), the conceptual analysis begins with Obrist's active coping hypothesis, that is, the hypothesis that beta-adrenergic CV adjustments vary with effort or task engagement. It continues by applying a theory of motivation intensity by Brehm that specifies conditions under which performers will be more and less task-engaged (Brehm & Self, 1989). One assumption of Brehm's formulation is that the motivational system is oriented toward resource conservation, which suggests that performers should expend effort (a) only to the degree that it is required and (b) only when doing so yields a sufficiently important benefit in terms of the attainment of something attractive or the avoidance of something aversive. A further assumption of the formulation is that effort is required to the degree that instrumental (i.e., approach or avoidance) behavior is difficult. This
in combination with the conservation principle suggests that effort should first rise and then fall sharply as difficulty rises, with the fall occurring where success is viewed as impossible or excessively difficult considering the importance of the outcome that it can yield. Because effort should bear a nonmonotonic (sawtooth) relation to difficulty, so should effort-related CV responses.

**Ability (Efficacy)**

Presumably, difficulty appraisals are determined in part by the nature of behavioral challenges with which performers are confronted. However, they also should be affected by performers' ability (efficacy) in regard to the challenges, with less able performers viewing success at any given objective difficulty level as harder than more able performers. This means that although effort and associated CV responses should first rise and then fall with difficulty for both low- and high-ability performers, these outcomes should be consistently stronger for low-ability performers so long as those performers view instrumental behavior as possible and worthwhile. In addition, the outcomes should drop at a lower difficulty level for low-ability performers because those performers should reach more quickly the difficulty level at which success appears impossible or excessively difficult. When an instrumental act calls for more than even high-ability performers can or will do, then effort and associated CV responses should be low for both ability groups.

**When Difficulty Is Unknown**

The difficulty of instrumental behavior is not always apparent. Consider, for example, untried soldiers caught suddenly in confusing crossfire. They would know that something needs to be done but could be at a loss as to what it might be. Brehm asserted that in such situations engagement should be proportional to (i.e., rise with) the perceived importance of the outcome that might be attained or avoided up to the point that the engagement attains its peak. Once people have reached the point beyond which they can engage no further, outcome importance should have no effect. Thus, in the soldiers' case, engagement should rise with the perception of what is at stake until it can rise no more. Because engagement should bear this relationship to outcome importance, so should effort-related CV responses.

**Potential Lessons**

What might these ideas tell us generally about the influence of motivation on CV response? We see at least five potential lessons. One is that a particular—and widely studied—class of CV adjustments might not derive from goals per se but rather from the effort that they engender. According to this view, goals such as those to attack, acquire status, or refrain from giving in to a behavioral impulse only create potential for CV responsivity. Whether that potential is realized depends on whether the goals translate into action, that is, engagement. Further, the extent to which it is realized depends on the degree of action generated.

A second potential lesson is that the conversion of goals into engagement and CV response can be anticipated by the application of relatively simple heuristics. When difficulty is known, effort and associated CV responses should (a) correspond to it so long as success is perceived as possible and worthwhile and (b) be low if success is perceived as impossible or excessively difficult, given the importance of the contingent outcome. When difficulty is unknown, effort and associated CV responses should correspond to the importance of the contingent outcome up to the point that performers can try no harder. Application of these heuristics could be enormously useful for interpreting and integrating studies concerned with goal pursuit. Application also could be useful for identifying conditions under which certain goals (e.g., those to achieve and control) may be associated with health risk.

A third potential lesson is that variables that determine the importance of outcomes being pursued might affect CV responses only indirectly via their impact on effort. Further (and relatedly), they might enhance these responses only under some conditions. As discussed previously, the ideas that we have outlined suggest that goals—no matter how important—convert into CV responses only insofar as they engender effort. The ideas also highlight conditions under which importance variables should and should not affect effort and associated CV responses. In theory, importance variables should affect effort and associated CV responses in two circumstances: (a) where difficulty is known and the variables determine whether effort requirements are justified and (b) where difficulty is not known and a performer's upper engagement limit has not been reached. By contrast, they should not affect these outcomes where difficulty is known and they do not determine whether effort requirements are justified. Nor should they affect the outcomes where difficulty is unknown and success is viewed as impossible. Richter (Chapter 4) addresses this lesson in detail when considering CV effects of one importance variable: reward. Other importance variables to consider are performers' need for available incentives, their expectancy of incentive attainment given successful execution of instrumental behavior (i.e., their outcome expectancy), and their expectancy of incentive attainment given unsuccessful execution of instrumental behavior.

A fourth potential lesson is that ability and variables that determine it might also affect CV responses only indirectly via their impact on effort and,
Cardiovascular response refers to changes in parameters such as heart rate, blood pressure, and heart contraction in reaction to an event or set of events. The chapters in this book, authored by an international group of distinguished scientists, show that applied motivational research has considerable predictability, informing us about cardiovascular responses and highlighting conditions under which those responses might pose a health risk.

This volume assembles some of the best, most interesting recent research on cardiovascular responses related to human motivation. It is true that, when motivated, people “put their hearts” into their efforts, and this collection of research shows us precisely how. The book will be of significant value to both researchers and advanced students in the field.

—Richard M. Ryan, PhD, Professor of Psychology, Psychiatry and Education, University of Rochester, Rochester, NY

This book gives a representative and accessible overview of recent work demonstrating that the cardiovascular effects of factors such as stress, uncertainty, conflict, social support, emotion, mood, task difficulty, and reward can be essentially reduced to motivational influences. It clarifies the underlying physiological mechanisms and brings together contributions from different settings and applications. It is important for scientists who are interested in cardiovascular responses from a basic, social, or clinical perspective.

—Anton van Boxtel, PhD, Associate Professor of Psychology, Tilburg University, Tilburg, The Netherlands

Finally! A book on motivation that moves beyond the common cognitive science perspective and dares to think of motivation in terms of the energization of goal striving. Because the book is very sophisticated in explicating the mechanisms and applications of this energization perspective, it may very well kick off an affective science of motivation. A must-read for both experimental and applied researchers of motivation.

—Peter Gollwitzer, PhD, Professor, Social-Personality Psychology, New York University, New York, NY