MOTIVATIONAL PERSPECTIVES ON CHRONIC PAIN

Theory, Research, and Practice

PAUL KAROLY
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EDITED BY PAUL KAROLY

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To my wife, Linda
(PK)

To my parents,
To Lieve,
To my children: Lien, Jana, and Ewout
(GC)

CONTENTS

PREFACE

Concepts of motivation have been ubiquitous in the behavioral sciences, expounded over many decades to reflect the importance of such diverse mechanisms as classical and operant conditioning, cognitive (expectancy-value) processes, social-contextual factors (socialization, priming, and modeling displays), as well as genetic, biophysical (homeostatic and allostatic), and neural forces. All of these psychological processes have been invoked singly and in combination to account for diversity and individual differences in the vigor and direction of human action. Even seemingly archaic notions such as will power and teleology, stemming from early Greek writings, have resurfaced in recent years under the aegis of control systems and self-regulatory models that have been expressly formulated to empirically illuminate the directive power of intended or anticipated end states or goals. Moreover, motivational models possess the capacity to integrate thought, affect, and behavior and to address both functional and dysfunctional modes of adjustment.

Yet despite the appeal of wide-ranging motivational constructs in psychology, pain science has only recently embraced their heuristic potential. The present volume was conceived to showcase the manner by which specific motivational formulations and their associated research methodologies have, in a relatively short span of time, demonstrated their considerable promise for advancing our understanding of the adaptive successes and failures of persons living with chronic pain. Although the

contributions to this volume diverge in content and focus, they share a common epistemic agenda: to illuminate the motivational mechanisms underlying pain adaptation. Equally noteworthy, the chapter authors reveal how the process of pain adaptation can unfold across distinct, but compatible levels of analysis—including the perceptual, cognitive, behavioral, emotional, developmental, and the neurobiological. The chapters comprising the present volume aptly illustrate the value of converging operations and multilevel thinking in the pursuit of a scientifically precise, conceptually integrated, and pragmatic pain science.

KEY ASPECTS OF A MOTIVATIONAL PERSPECTIVE

Despite the diversity of theories and methods directed at explicating the concept of motivation over the years, the topic maybe usefully approached by noting a few defining attributes. And although not every author of a chapter in this volume would necessarily endorse all of the following premises, the short listing can nonetheless be read as providing a broad organizational frame for this book.

First, humans are assumed to be naturally goal directed and error sensitive to varying degrees and in various contexts. Hence, when seeking to identify the most relevant and robust bio-psycho-social processes that may serve to link acute or chronic physical pain to distinct physical and mental health outcomes, researchers and clinicians can gain a foothold on the causal complexity by zeroing in on the intersection of potent external-stimulus conditions (those involving threat, challenge, and/or error) and the interiorized processes of prospection and self-direction. Pain (like other physical symptoms) exists within each individual's idiosyncratic and dynamic life space—a "space" that is regularly shaped not only by immediate physical sensations, cultural antecedents, life span conditioning, and diverse neurobiological constraints but by the individual's context-sensitive, cognitive-affective reactions and self-directive efforts.

Despite the undeniable power of incentives (rewards and punishments), motivation is not just about the initiation of directional action, but is also

about "what to do next." Hence, the motivated person (or animal) creates relatively stable (but modifiable) working models of him/herself and of the expected world so as to anticipate and prepare for what is to come. Pain, as we shall see, holds the potential to shape and/or distort people's prospective reference frames (i.e., their internal models, schemas, mindsets, simulations, or predictive codes). Although some pain-derived schematic alterations are relatively minor, others threaten a key aspect of what is here considered a key requirement of a viable motivational system—namely, its flexibility. Illustrations of rigid, unproductive, and self-defeating patterns of pain construal and management are detailed in several of the chapters in this volume, as are attempts to regulate and reframe pathogenic modes of pain adaptation.

Although wants and desires are important and would appear to lie at the heart of the concept of motivation in the minds of classical philosophers, as well as laypersons, motivation involves a great deal more than focusing on hoped-for states or outcomes (the *what* of motivation). Individuals and collectives must possess a variety of skills, resources, capacities, proclivities, and situated opportunities in order to eventually actualize their intentions (the *how* of motivation). Of critical importance is the bidirectional relation between pain and regulatory skills and affordances. That is, although pain can derail well-intentioned and self-directed efforts to skillfully traverse the path from wanting to having, regulatory skills and resources, when effectively mobilized, can provide the means to overcome pain's often deleterious effects on personal striving and its adaptive offshoots.

Having noted that motivation involves more than the process of activation and incentivizing, it is nonetheless important to recognize the immutable links between cognitive self-direction/control and affective processing. Any motivated action that leads to the successful attainment of a goal necessarily represents an integrated and dynamic pattern of perception, thought, and emotionality unfolding in a potentially facilitative context.

Finally, motivation is not a polarized, either-or construct. It is a process rather than a fixed condition; and therefore it cannot be characterized as

either switched on or off, either externally or internally controlled, or essentially grounded in the past or the present or the future. The process of motivation is built upon multiple interacting mechanisms unfolding continuously in real time and across diverse settings. Thus, for example, labeling some individuals as "unmotivated," insufficiently driven, or lacking in "readiness" serves to de-contextualize a dynamic, time-and-place-sensitive process and replaces a living system with a simplistic evaluative judgment. Moreover, if a presumptive motivational deficit (low motivation) must be inferred from an actor's performance (e.g., lack of task initiation or completion), the ostensible explanation is circular. In a like manner, the discipline of *motivation science* must seek to avoid premature paradigmatic commitments, but rather remain open to the use of multiple methods for the discovery of robust motivational phenomena and for the generation and testing of potent explanatory models.

OVERVIEW OF THE PRESENT VOLUME

Providing a broad orientation to the field, Chapter 1 introduces a perspective that pivots on the role of goals and self-regulatory processes in human adaptation and its failures. In this chapter, Karoly articulates the defining features of *motivation* within an emerging control-systems framework organized around social/contextual, cognitive, and affective components that can be applied at both the between-person (nomothetic) and within-person (idiographic) levels. Three premises and their supportive data undergird the material in this chapter. First, goal-related thinking, feeling, and striving are said to interact with acquired self-regulatory skills, resources, and strategic knowledge to lay the foundation for successful life task management and emotional well-being. Second, the cumulative impact of chronic pain tends to compromise goal-guided self-regulation. And, finally, effective goal cognition and well-developed self-regulatory capacities and cognitions can facilitate day-to-day adjustment even in the face of chronic pain.

Chapter 2 offers a review of classical and contemporary models of pain with a special emphasis on its neural underpinnings (e.g., the pain connectome) and the intersection of pain and cognition. Moayedi and Davis describe the application of imaging and neurophysiological methods that have opened new frontiers in our understanding of acute and chronic pain and of the mechanisms pertaining to the acute-to-chronic transition. The process of attending to pain (a topic discussed widely in other chapters in this volume) receives an especially creative treatment in this chapter, as does the nature of "brain abnormalities" in persons with chronic pain. Readers will come away with an appreciation of how pain sensations are processed in the brain and of how defensive motor processes serve to protect us from the threat posed by persistent aversive stimulation.

In Chapter 3, Hamilton, Atchley, Boddy, Benau, and Freche apply a motivational theory to clarify the nature of cognitive control and emotion regulation in the context of chronic pain. After reviewing pain research tied to a goals perspective, the authors address adaptive and maladaptive cognitive control process and their means of assessment. They organize their insights around an Anticipatory Theory of Pain (AToP), integrating supportive research across several distinct levels of analysis and suggesting novel clinical applications.

Learning and conditioning and their links to chronic pain are the subjects of Chapter 4. Mirroring Chapter 2's emphasis on the role of *defensive operations* in pain modulation, Vlaeyen provides a deft accounting of how associative learning can contribute to the stubborn persistence of chronic pain, while recognizing that the experience of pain may also affect the processes of learning. Throughout, Vlaeyen embeds the discussion of learning within a larger explanatory framework, one that acknowledges the role of cognition (e.g., memory and expectancy), the motivational context (e.g., goals and social threat cues), and emotionality (e.g., fear and worry). Readers are guided through the multifaceted terrain of classical conditioning, including the role of stimulus generalization and extinction, and of operant conditioning, with a focus on avoidance and "occasion setting" stimuli. The organizing premise of the chapter, that pain-related

learning is "not a simple process," is a necessary antidote to a simplistic de-conditioning view.

Chapter 5 links chronic pain to the central role of stress as well as to the power of a key dimension of non-associative conditioning—sensitization. Veldhuijzen, van Middendorp, and Evers build a case for a multileveled view of stress (threats to homeostasis) and sensitization (response amplification after repeated stimulus exposure), and consider how both serve as causes and consequences of chronic pain. The authors review the psychobiology and the assessment of stress and sensitization (including central sensitization) and appraise the evidence linking these constructs to chronic pain. Also discussed are psychological and pharmacological interventions that target stress and sensitization in chronic pain. Finally, the authors propose a motivational account, one supported by neurobiological evidence, in which the effects of nociceptor activation on the experience of pain can be shown to be modulated by diverse emotional and cognitive factors (many of which are featured in other chapters of the current volume).

A motivational rendering of the role of attention and attentional processes in pain is comprehensively presented by van Ryckeghem and Crombez in Chapter 6. Starting with the non-controversial assumption that pain demands attention and tends (but not invariably) to interrupt ongoing, goal-directed action, the authors provide an in-depth analysis of attention, attentional functions, and their moderators, with a focus upon how these processes link to chronic pain. Readers are introduced to models of the attention system pivoting on concepts such as limited resources, multitasking, and stages of processing, as well as to cognitive-affective and neurocognitive conceptions that transcend resource limitations by invoking the dynamic interplay between top-down and bottom-up modulators. The chapter presents a motivation-centered account of the pain-attention nexus that builds upon goal and self-regulatory constructs, provides a thorough review of literature in support of their theoretical analyses, and offers an insightful commentary on future research and applied directions.

Chapter 7 examines the social/interpersonal context within which individuals with chronic pain are subject to both helpful and unhelpful responses from their caregivers. Kindt, Goubert, Vansteenkiste, and Vervoot review several distinct models of the impact of social agents upon the pain experience, drawing from an array of conceptual systems. Finding gaps in existing approaches, the authors suggest that the Self-Determination Theory (SDT) model may serve as a useful conceptual and clinical adjunct. Built around the pivotal role of psychological *needs*, the tenets of SDT imply that caregivers to persons with pain should seek to support patients' needs for autonomy, competence, and relatedness. Moreover, as SDT distinguishes between types of motivation for caregiving located along a continuum from *controlled* to *autonomous*, the authors argue (a) that caregivers who are attuned to their own motives can facilitate pain-related outcomes in those they support, and (b) that successful attunement often depends on caregivers' effective regulation of their own goals and emotions.

The opposing motivational processes of avoidance and endurance among persons with chronic pain are the focus of Chapter 8. Hasenbring and Kindermanns address the apparent *goal conflict* underlying the desire of the person in pain to maintain valued life activities and to escape or avoid the current aversive experience. The authors proffer, and provide empirical evidence in support of, an *avoidance-endurance model* that details both productive and unproductive means whereby chronic pain sufferers seek to resolve the approach-avoidance dilemma that often penetrates and upends their lives. In addition to a fear avoidance pathway, the authors suggest that distress endurance and eustress endurance represent two other potentially dysfunctional modes of responding. These maladaptive modes are contrasted with an adaptive mode of responding characterized by positive cognitions, the absence of negative emotions, and the ability to shift between short-term avoidance and goal-centered endurance. The motivational elements presumed to undergird adaptive success or failure are said to pivot around such constructs as self-discrepancies, reward seeking, and habitual mindsets.

Chapter 9 by Claes and Gebhardt likewise highlights the links between chronic pain and goal conflict but seeks to unpack the conflict process and its varied forms, particularly as they pertain to the structure of people's goals and to their pursuit of multiple goals. After reviewing some essential features of goal psychology, the authors consider how goal frustration and attempts to cope with frustration influence adjustment to chronic pain. Next, they foreshadow the content of several upcoming chapters in this volume by addressing psychological interventions for chronic pain that target goal conflict and frustration, including Motivational Interviewing, Acceptance and Commitment Therapy, and self-regulation strategies. A central theme of this chapter, one that is echoed across many other chapters in this book, is that to be fully understood, chronic pain should be *motivationally contextualized*—that is, framed against the background of people's goal-directed actions, thoughts, and emotions.

Chronic pain's complex and controversial relationship to psychological/psychiatric disorders is the subject of Chapter 10. Organized around the GRASSP perspective (introduced in Chapter 1), Karoly's discussion centers on articulating how a control-systems motivational model, one built around goals and self-regulatory support processes, can illuminate the complex interplay between pain, pain processing, task performance, and the emergence of psychosocial symptoms in persons with chronic pain. Assuming (a) that chronic pain is capable of disrupting self-regulatory system functioning, and (b) that dysfunctional self-regulation is the final common pathway underpinning most forms of psychosocial maladaptation, the author proposes a series of pain-compromised regulatory moderator mechanisms capable of undermining the goal-striving process at distinct points in time, thus setting the stage for the emergence of depressive and/or anxiety symptoms.

In keeping with this volume's motivational emphasis, Jensen's Chapter 11 provides a clinically rich and compelling account of Motivational Interviewing (MI), a widely used and empirically validated approach to chronic pain management. As many pain patients are ambivalent about making life changes and often tend to be resistant to treatment recommendations, MI has emerged in recent years as a modality that seeks

to establish a patient-clinician partnership built around strengthening the patient's self-directed commitment to change. Providing numerous examples of patient-therapist dialogues, Jensen adroitly illustrates the MI processes of *engaging, focusing, evoking,* and *planning.* For example, in seeking to support patient engagement, clinicians can make use of such techniques as open questioning, reflecting, affirming, and summarizing—all of which are aptly exemplified in the authors' clinical examples. Rounding out his presentation, Jensen reviews the empirical findings on the efficacy of MI.

Van Damme and Crombez provide a motivational perspective on coping with chronic pain in Chapter 12. After clarifying the meaning of coping and noting some of the problems associated with a reliance upon purely descriptive structural models of the stress-coping process, the authors recast the coping construct within a goal-based, self-regulatory framework (akin to the GRASSP model outlined in Chapter 1). Several extant self-regulation and goal-centered formulations of coping and its effects are reviewed as a prelude to the authors' account, one that articulates a process whereby pain's interference with goal pursuit triggers negative affect that, in turn, activates coping responses that may follow three possible trajectories: goal persistence, problem solving, or goal adjustment. Van Damme and Crombez reiterate the argument (made by several chapter authors) that the context largely determines whether specific coping strategies are adaptive or maladaptive. And they show how familiar concepts, like fear avoidance and catastrophizing, can be understood in new and useful ways when viewed through the lens of their motivational model.

With the motivational centrality of affective processing and emotion regulation duly noted in previous chapters of this volume, the authors of Chapter 13 carry the discussion forward by addressing the topic of *pain-affect dynamics* and its clinical implications. Davis, Mun, Kothari, Moore, Rivers, Thummala, and Weyrich, after acknowledging that pain adversely affects positive as well as negative emotional health by means of its influence on diverse motivational systems, turn their attention to the "real time," dynamic relations between pain and emotional experience. The authors

review laboratory-based experimental findings comparing healthy, pain-free persons to those with chronic pain, revealing the detrimental effects of negative mood manipulations on pain tolerance and perceptions of pleasantness. With an eye toward complex temporal processes, they subsequently discuss findings from diary-based, micro-longitudinal research on pain and affective fluctuations in natural settings. Applying the influential Dynamic Model of Affect (DMA), Davis and her colleagues uncover intriguing patterns (such as how acute pain fluctuations shape affective differentiation among persons with chronic pain) and then extrapolate their insights toward the goal of improving clinical intervention.

Contextual factors and learning processes come together in Chapter 14, as conceived by McCracken and Scott. The Psychological Flexibility model (inspired by Acceptance and Commitment Therapy; ACT) provides an organizing motivational framework that complements the approaches articulated in the other chapters in this volume. McCracken and Scott, viewing motivation as occurring via the joint action of history, language, and cognition, offer a contextual, cognitive-behavioral science perspective on pain, wherein the causal forces underlying maladaptive action and/or self-management are coordinated situationally (selection by consequences) and by acts of relating events within language or via verbal-cognitive processes (rule-governed behavior). The authors detail several key motivational concepts, such as pliance, tracking, and motivational augmentals, and describe how the Psychological Flexibility (PF) model drives clinical application. The authors conclude by summarizing the empirical support for their approach to motivation.

Technological innovation in chronic pain treatment takes center stage in the last chapter of this volume. Ruehlman and Wilson present in Chapter 15 a thorough and incisive review of Internet-based programs directed at teaching self-management skills to persons with chronic pain problems. In light of the cost and inaccessibility of face-to-face therapy/patient education for a great many people with persistent pain, the emergence of Internet-based self-management methods represents a genuine breakthrough in service delivery. In their chapter, Ruehlman and Wilson outline the nature (the targets or treatment goals), the recruitment process,

and the efficacy to date of electronic self-management-focused intervention tools, detailing strengths, limitations, barriers, and challenges for the future. Readers unfamiliar with electronically mediated change/education methods will find within this chapter a wealth of practical information and perhaps the realization that patient-centered interventions for chronic pain need no longer be shackled by the four walls of a consulting room.

The editors expect that this volume will provide readers with a new or a renewed appreciation of the potency of motivational constructs in pain science. We believe that a motivational perspective, broadly defined, holds considerable promise for enhancing our understanding of the intersection of chronic pain and the enterprise of living; and we further expect that, in the coming years, researchers, clinicians, and especially patients will continue to explore and exploit the richness and the subtle elegance of the ideas herein expressed.

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SECTION I

Fundamental Concepts and Models

1

A Goal-Centered, Self-Regulatory Model of Motivation and Its Relevance for Advancing the Study of Chronic Pain

PAUL KAROLY

Motivational science is concerned with the nature and functions of wanting and their relation to knowing, feeling, and doing.

—Higgins and Kruglanski (2000)

If we know the goal of a person, we can undertake to explain and to understand what the psychological phenomena want to tell us . . . how his character traits, his feelings and emotions, his logic, his morals, and his aesthetics must be constituted . . . why and to what extent he deviates from . . . normal.

—Alfred Adler (1929), *cited in Ansbacher and Ansbacher (1956)*

Motivation is what makes the world go round.

—Harmon-Jones and Forgas (2014)

1.1 INTRODUCTION

Over the years, many diverse human accomplishments have been linked to the concept of *motivation*. From sustaining engagement in difficult and time-intensive undertakings such as school-related studies to gaining control over the habitual use of addictive substances, the display of unconstrained persistence in the pursuit of delayed benefits and the establishment of self-guided jurisdiction over health-damaging thoughts and actions have traditionally been attributed to the workings of such enigmatic capacities as willpower, volition, self-control, or ego strength (cf., Hassin, Ochsner, & Trope, 2010; Karoly & Kanfer, 1982; Mischel, Cantor, & Feldman, 1996). Constructs such as these are said to represent a set of presumably intrapsychic processes invoked, often after-the-fact, to explain the state of *being motivated*. In a similar vein, basic and applied scientists have struggled to grasp the complexities of adaptation to persistent and often debilitating physical pain, seeking to understand the range and the variation in people's behavioral and emotional reactions, as well as their ability and willingness to stay engaged in valued life pursuits despite the burden of ongoing somatic distress. The aim of this chapter (and the overarching theme of this volume) is the delineation of an emerging conceptual and pragmatic bridge between the mechanisms of pain processing and the regulatory dynamics of human goal-guided motivation.

In seeking to appraise the myriad consequences of physical pain and the processes that may exacerbate, moderate, mediate, and/or maintain its deleterious effects, experimental, clinical, and social psychologists, neuroscientists, psychiatrists, nurses, and others have examined a broad range of bio-psycho-social constructs. In a discussion of the American Pain Society's efforts to forge a multidimensional pain taxonomy organized around empirically supported mechanisms, Turk, Fillingim, Ohrbach, and Patel (2016) summarized an array of components that populate dimensions 4 and 5: psychosocial and behavioral factors. Included in their listing are mood/affect (e.g., depression and anger), beliefs, appraisals, expectations, and coping processes (e.g., self-efficacy, helplessness), and

indices of physical functioning /disability (e.g., interference with daily activities, sleep patterns). Without denying the importance of any of these facets, it is noteworthy that the topics of *goal-guided and incentive-based motivation* were touched upon only obliquely.

Chronic pain is viewed here as a noxious and potentially inescapable trigger that, like chronic stress or trauma, often precipitates cognitive and emotional disturbance and behavioral impairment/disability. Such effects are believed to be influenced by a diverse set of motivational mechanisms, including

- The taxing of attentional resources (Eccleston & Crombez, 1999; Grisart & Plaghki, 1999; Schoth, Nunes, & Liossi, 2012)
- The emergence of unproductive goal pursuits and/or the displacement of prior goals by pain-avoidance goals (Hamilton, Karoly, & Zautra, 2005; Karsdorp & Vlaeyen, 2011)
- The mitigation of normative goal appraisals (e.g., Crombez, Lauwerier, Goubert, & Van Damme, 2016; Karoly & Lecci, 1997)
- The weakening of goal-congruent emotions (happiness and positive arousal), the strengthening of negative affectivity (Crombez, Viane, Eccelston, Devulder, & Goubert, 2013; Hamilton, Karoly, & Kitzman, 2004)
- The disruption of goal-relevant cognitive operations (e.g., memory, attitudes, social information processing, value-based decision making; Ferguson & Porter, 2009; Gollwitzer & Moskowitz, 1996; Karoly, Okun, Enders, & Tennen, 2014; Lazarus, 1991)
- The breaking of the reciprocal connections among goals, emotions, and actions (cf., Dohrenbusch, Buchanan, Lipka, & Ott, 2008; Karoly, Okun, Ruehlman, & Pugliese, 2008; Toates, 2004)

In short, when goal-related thinking and self-regulated goal striving are compromised to varying degrees by persistent pain, the resulting motivational dysfunctions can assume the role of potent vulnerability factors capable of undermining an array of vital pain-performance relationships.

However, as an important counterbalance, motivational processes that pivot on the well-honed capacity to effectively self-regulate one's thoughts, emotions, and actions in the service of goal pursuit, though not quite so formidable as to exert an influence upon the earth's rotation, nonetheless appear capable of modulating not only the topography, variability, and malleability of the pain experience, but also pain's typically insalubrious consequences for psychosocial adjustment (as is more fully addressed in Chapter 10 of the present volume). Thus, goal cognition and self-regulatory processes working in tandem across supportive environments can serve as protective or resilience factors, reducing pain's deleterious effects on everyday performance and emotional well-being. Therefore, notwithstanding the fact that pain and its effects have been productively linked to physical, neurological, genetic, biochemical, learning-based, attitudinal, and behavioral mechanisms, a strong warrant exists for approaching the multileveled process of pain adaptation from a *motivational systems* perspective as well, one that may eventually help unify insights gleaned across the spectrum of pain disciplines.

Although the implications of the presumptive reciprocal relationship between pain adaptation and goal-centered motivation are currently being vigorously explored, much remains to be discovered. This introductory chapter provides an overview of the motivational terrain as conceived within a control systems/self-regulatory rendering, one that I have dubbed the *Goal-Centered, Self-Regulatory, Automated, Social Systems Psychology* (GRASSP) perspective (cf., Karoly, 2010a).

The GRASSP approach follows a descriptive and explanatory track that both intersects and runs parallel to the traditional, learning-based Arousal /Incentive/Invigoration (AII) model of human and animal motivation (Cofer & Appley, 1964; Mook, 1996). In light of its strong position within the field, I shall say little more about AII models of motivation except to acknowledge that the energizing, cueing, and reinforcing power of conditioning and learning creates and helps to sustain many of the regulatory mechanisms that I shall be considering in this chapter (cf. also Dworkin, 1993; Staats, 1975). The aim of this introductory chapter is to illustrate the integrative potential of a motivational model predicated on

the assumptions that (1) on a day-to-day basis, goal-guided self-regulatory processes *build upon yet transcend* the effects of biophysical states and contextual cues and incentives, and (2) motivational operations organized around goal striving processes are capable of mediating or moderating, for good or ill, the impact of persistent pain experiences upon everyday task performance.

1.1.1 Some Historical Background

Prior to outlining a social cognitive/control systems framework, I briefly consider some historical antecedents, beginning with a clinical and research movement that dealt specifically with the study of pain. In the 1970s, when medicine reigned as the dominant pain science discipline, a new field called *behavioral medicine* was emerging as an outgrowth of the learning-theory-inspired behavior therapy movement (cf., McNamara, 1979). During this period, Wilbert Fordyce arrived on the scene to pioneer the application of operant methods to the management of persons with chronic pain. He sought to demonstrate that a Skinnerian paradigm, in conjunction with occupational therapy, could be mounted in an inpatient setting with the goal of reducing the experience of pain, the use of pain medication, and pain's interference with the activities of daily living (Fordyce, 1976). Fordyce's innovative work garnered a great deal of attention, enhancing the credibility of psychology as a "health discipline" and supporting the emergence of the more inclusive social science framework called *health psychology* (Stone, Cohen, & Adler, 1979). Techniques including biofeedback, hypnosis, relaxation training, and stress management joined operant conditioning as viable treatment modalities, and research on social ecological factors in health and illness likewise flourished. In short, physicians and allied health professionals were being joined by psychologists in the quest for better ways to assist persons dealing with both physical and psychological pain.

Yet, anticipating the current interest in trans-diagnostic mechanisms, investigators in the 1970s and 1980s also began inquiring about common

factors that might be operating across the growing array of bio-psychosocial interventions. Not surprisingly, cognition and emotion rose to prominence within the new science of behavioral medicine/health psychology, paralleling their importance in clinical and experimental psychology. Thus, building upon Melzack and Wall's (1965) classic gate-control theory, Turk, Meichenbaum, and Genest (1983) put forward a well-received cognitive-behavioral model of chronic pain and its remediation, further stimulating the study of cognition as a significant interactive element, along with complex sensory and affective processes, in the process of chronic pain adjustment.

During this growth period, motivational constructs were certainly included in various formulations of adaptation; yet they were often conjoined to fundamental learning theory accounts centering on incentives, states of arousal, and performance activation. Consequently, the person-mediated process of goal directedness did not receive much systematic attention. Yet even as operant and classical conditioning applications were seeing ever wider clinical acceptance, questions were being raised about the absence of compelling evidence for the transfer of learning from controlled settings to the real world and about the limited long-term effects associated with strict behavioral interventions (cf., Karoly & Steffen, 1980). In addition, nascent efforts were under way to develop technologies capable of enabling patients to anticipate and *self-impose (*or *self-manage)* the cues and reinforcement contingencies in their everyday environments, thereby allowing them to assume greater and more durable control over their own lives (Kanfer & Phillips, 1970; Karoly & Kanfer, 1982; Mahoney & Thoresen, 1974).

Perhaps the most direct conceptual link to the GRASSP model is the seminal work of Albert Bandura (e.g., 1991), who systematically articulated a self-regulatory perspective on motivation for over five decades. He proposed that sustained action toward distant goals can be attributed to physiology (acknowledging AII models), social and tangible incentives, and, most centrally, to forethought and cognitive representational capacities. He proposed and garnered evidence in support of the notion that self-evaluative and self-reactive influences (self-regulatory skills and

appraisals) are key mediators of goal motivation, and that certain goal properties (e.g., goal specificity, goal challenge, goal proximity) determine how effectively the self-regulatory system will be enlisted to facilitate goal attainment. In view of the fact that, in their natural environments, humans pursue multiple goals under challenging and often unpredictable conditions, Bandura afforded special significance to individual differences in *self-efficacy* beliefs,[1] cognitive judgments about one's capability to organize and execute actions directed at specific outcomes, that are presumed to be singularly capable of empowering regulatory efforts.

Finally, the contributions of European *action theory,* Russian *activity theory*, and Heckhausen's Rubicon model of volition must be acknowledged as additional noteworthy forerunners of the self-regulatory conception presented in the present chapter (cf., Achtziger & Gollwitzer, 2008; Bedny, Karwowski, & Bedny, 2001; Frese & Sabini, 1985; Kuhl & Beckmann, 1985). The action theory model as articulated by von Cranach (1982), for example, presumes that goal-directed action is situated, planned, and organized sequentially and hierarchically; occurs in conjunction with conscious cognition; and is dependent upon feedback processes. Similarly, Russian activity theory stresses the analysis of complex systems of goal pursuit that are proactive rather than simply reactive to current affective stimulation. And the Rubicon model acknowledges the role of time in the continuously unfolding process of goal directed action by postulating key transition points separating the predecisional, postdecisional, actional, and postactional phases of goal setting and goal pursuit.

Thus, in the hands of creative thinkers from different countries, from different disciplines, and working at different points in time, motivation has come to be defined as the study of *action control and action management in the service of goal attainment.*

Whereas the GRASSP model is consistent with traditional accounts of associative and action-outcome learning (classical and operant conditioning), non-associative learning (Overmier, 2002), fear and avoidance learning (Wiech & Tracey, 2013), evaluative conditioning, and reward

1. A Pain Self-Efficacy Questionnaire has been developed (Nicholas, 2007).

signal learning (Marien, Aarts, & Custers, 2016), it also draws upon the cognitive social learning (e.g., Bandura, 1987, 1991; Barone, Maddux, & Snyder, 1997) and control systems frameworks (e.g., Carver & Scheier, 1990, 1998; Ford, 1987; Powers, 1973; Toates, 2004) in such a manner as to capture and pragmatically leverage the unique human capacities for self-reflection, prospection, feedback-guided action, and uncertainty management.

1.2. PERSONAL GOALS, GOAL SYSTEMS, AND SELF-REGULATORY COMPETENCIES: A DESCRIPTIVE AND DEFINITIONAL OVERVIEW

1.2.1 Personal Goals: Their Nature and Functional Significance

Despite a 21st-century resurgence of interest in motivational topics cutting across an array of psychological disciplines (cf., Higgins & Scholer, 2015; Kruglanski, 2016) and following on the heels of the models and ideas alluded to earlier, many investigators addressing so-called motivational factors in normal and pathological behavior have been, until relatively recently, committed to the view that conscious or explicit *personal goals* (a.k.a. personal strivings, projects, current concerns, life tasks, etc.) are roughly equivalent to wishes, hopes, daydreams, fantasies, or vaguely formulated intentions. And because goals appear on the surface to be fairly evanescent psychological musings, they could be expected to link only modestly to critical decision-making and instrumental action via the traditional expectancy-value route (Eccles & Wigfield, 2002; Locke & Latham, 1990). Indeed, one critic (Nuttin, 1984) suggested that because goals do not physically exist, they lack causal efficacy. Consequently, goals have been viewed by many as possessing comparatively minor predictive potency in comparison to *unconscious motives* or *automatic primes* (cf., Aarts, 2007; Custers & Aarts, 2005; Moors, 2016). Moreover, should psychologists seek to mine self-consciously accessible aspects of human intentionality, it seemed obvious to many observers that the purest

nuggets were to be found within the more traditional domains of *traits, motives,* and/or *temperaments,* with goals serving as mere derivatives or correlates of these more stable and ostensibly higher-order and biologically grounded individual differences (McAdams, 2001; Pervin, 1989; Schetter & Heckhausen, 2008). Finally, in light of the presumed connection between goals and such outdated concepts as drives and vital forces, critical commentators dismissively assumed that formulations built around goal constructs would hardly be worth the effort. Behaviorists in particular displayed a skeptical attitude toward what they considered to be insubstantial mentalism stemming from inferred and largely unverifiable, ghost-like intra-psychic contrivances (e.g., Pronko, 1986). For such researchers, *motivation* has meant (and continues to mean) little else but the provision of powerful incentives to action.

Although such presumptions linger, they no longer predominate. Goal constructs have attained a notable degree of respectability across an array of disciplines—including clinical and social psychology, personality, health, developmental, cognitive and applied psychology, and the neurosciences—by virtue of the growing recognition that goals lie at the heart of motivated action, social cognition, well-being, and adaptive problem solving (Austin & Vancouver, 1996; Boekaerts, 2010; Bogdan, 1994; Carver & Scheier, 1998; Fiske & Taylor, 1991; Karoly, 1993a, 1999; Kruglanski, 2016; Moskowitz & Grant, 2009; Rusk & Waters, 2015; Waszak, Springer, & Prinz, 2010). Goals are currently believed to be instantiated at the operational core of complex brain-behavior systems and may represent a useful vehicle for the anticipation and regulation of everyday discrepancies, uncertainties, inconsistencies, and mismatch errors (Cole, Repovs, & Anticevic, 2014; Gerlach, Spreng, Gilmore, & Schacter, 2011; Hirsh, Mar, & Peterson, 2012; Karoly, 2012; Power & Petersen, 2013; Proulx, Inzlicht, & Harmon-Jones, 2012). In short, *being motivated* may be equated to *being goal-directed*; and humans can be viewed as purposeful, feedback-sensitive, and feed-forward-driven goal-striving systems (Ford, 1987; Lord & Levy, 1994; Mansell & Marken, 2015). In order to assist the reader to fully appreciate these assertions, a more detailed analysis of some foundational premises and constructs is presented next.

First, a goal should be understood as more than simply something a person wants (an incentive) or a hoped-for end state not yet attained. Rather, a goal may be more precisely defined as *a feedback-sensitive, abstract (symbolic) or concrete (imagistic) anticipatory mental representation of a personally meaningful outcome (or incentive, purpose, intention, performance standard, set point, experiential process, or state) that an individual or group expects to attain or to approach or, if disadvantageous, to prevent, avoid, or minimize, and one that is framed and pursued relative to readily perceived and realistically available alternative options.*

Goals are activated at the hub of a bio-psycho-social *control system,* a complex, hierarchically organized network that draws upon a set of functional competencies that have evolved within our species to deal with an unpredictable, challenging, and sometimes threatening environment. The control system works to maximize the likelihood that when one or more of its inner reference signals (set points, command functions, controlled quantities, or goals) is confronted with an unexpected divergence, change, error, mismatch, or challenge, the system will engage in a process of reconciling the perceived mismatch or misalignment. When discrepancies occur between a perceptual input signal and a reference standard or goal, the system encodes this discrepancy and "takes action" to correct or negate the mismatch (cf., Carver & Scheier, 1998; Ford, 1987; Karoly, 1993a; Powers, 1973). The term *negative feedback* refers to the situation in which information about a disturbance precipitates action to oppose or "negate" that disturbance. It is important to note that such a system operates not just on the basis of feedback (knowledge of what is currently happening), but is also proactive or future directed by virtue of what control theorists call the *feed-forward* function—the capacity of the regulatory system to draw upon the person's knowledge base to allow the actor to anticipate the future and activate the next instrumental action or, if deemed necessary, to alter his or her direction. Control systems are, therefore, both proactive and reactive.

A room thermostat paired with its associated air handler is a common example of a simple mechanical control system, one that works to maintain the desired room temperature (the goal, set point, or reference

standard) when one of its functional components (a thermometer) senses that the room is either too hot or too cold (a so-called error signal) and feeds this information to a comparator (or comparison) function whose job is to recognize the discrepancy and activate requisite corrective action (via so-called control and action functions; cf. Ford, 1987). The action of blowing hot air out of the room or directing cold air into it is the operation that serves to keep the room temperature within the range specified by the goal (or directive function). The air conditioner turns off when the room temperature matches the set point.

Of course, one shouldn't push machine or robot analogies too far. Humans do not "turn off" or go into "sleep mode" when a discrepancy is reduced because, unlike inanimate machines, living organisms continuously strive for multiple goals under conditions that often challenge their skills and resources. Moreover, people do not consider every sensed discrepancy as necessarily worthy of their corrective efforts. Rather, they apply personally meaningful weightings to the experienced mismatch based on such considerations as the goal's importance and the likelihood of negative consequences attendant to the discrepancy. Nor are people plugged into a constant supply of power, but must actively gather energizing resources (nutrition and affective arousal) from their surroundings. Also, under routine or predictable circumstances, people function quite well by operating on "automatic pilot," relying upon prior conditioning or priming to cue the requisite habitual actions. For humans (as opposed to machines) being *goal-directed* or *motivated* can thus be taken to mean that a person's actions, thoughts, or emotions/moods occur under the conditional or probabilistic control of a family of goal representations (diverse and sometimes conflicting reference signals) that are subject to top-down (conscious or self-evaluative) and bottom-up (non-conscious) self-regulatory influences (see further in the chapter for a fuller description of how self-regulatory functions operate within a control systems framework). Furthermore, assuming a "human perspective" on negative feedback and feed-forward control implies that the day-to-day pursuit of goals and incentives in an uncertain world is a process that infuses life with meaning (Klinger, 1977).

The complex representations called goals vary in their content; their representational and organizational structure; the propositional frames within which they are interpreted; their affective intensity; their temporal range; and in the manner in which they are behaviorally expressed, interpersonally communicated, and episodically pursued. When activated, focal goals (i.e., those goals currently accessed in the expectation of being pursued) are subject to multiple constraints on their behavioral enactment. These constraints include the availability of supportive self-regulatory resources, fluctuations in expectancies, situational demands, conflicts with other active goals, physical fatigue, social supports and hindrances, and the possibility of displacement by attractive alternative pursuits. Note that although the term "representation" in this definition suggests a fairly static symbolic construction, the goal concept is best understood as fluid, operating proactively in the service of anticipated future actions and as unfolding within a mutable, skill-based, and event-related enactive system (see Bruineberg & Rietveld, 2014; Engel, Maye, Kurthen, & Konig, 2013). That is, in contrast to presumably fixed mental elements (e.g., dispositions, motives, values, or needs) or stimulus-bound reaction tendencies (e.g., impulses, desires, cravings, or drives) and to short-term intentions (e.g., pick up a bottle of milk on the way home from work), goals perform their work with the assistance of *elaborative reasoning* about the what, where, when, why, and how of their pursuit (cf., Samsonovich, 2014; Vershure, Pennartz, & Pezzulo, 2014). The definition also stipulates that goals are pursued relative to alterative options. Striving for a specific end point in the absence of realistically available alternatives represents motivational constraint or coercive control.

In sum, goals can be considered prospective (feed-forward) thought systems that, operating in concert with feedback-sensitive, self-regulatory course-correcting mechanisms, can serve as context-specific *volition engines*, transforming or configuring often vaguely articulated and general attitudes, beliefs, values, interests, commitments, or "good intentions" into concrete, measurable, and contextually appropriate actions and emotions. Or as succinctly stated by Miceli and Castelfranchi (2015), goals operate as "potentially conduct-controlling anticipatory

representations" (p. 5). And as I shall describe in greater detail ahead, maladaptive forms of goal processing and dysregulated goal pursuit in persons with persistent pain may serve to perpetuate their day-to-day performance deficits even when surgery, medication, or other clinical interventions have significantly modified their distressing or hurtful sensory/affective experiences.

Although people often articulate relatively long-range, delayed-payoff goals (i.e., "To converse skillfully in French," "To graduate from law school," "To take control of my pain"), they rarely reach the finish line in a single bound. Therefore, when the term *goal* is used in this chapter, it can also be read as *subgoal*—that behaviorally addressable segment of a multistep aspirational agenda currently attracting attention, consuming resources, and generating success/failure feedback. Striving toward long-range goal attainment is therefore an iterative process, one constructed of context-bound, sequential subgoal enactments, the subjective appraisals of which produce time-sensitive and often fallible estimates of goal progress. Indeed, it has been suggested (Huang, Zhang, & Broniarczyk, 2012) that progress estimates tend to be exaggerated early in the goal-pursuit process and then downplayed closer to goal completion, presumably to facilitate the efficient mobilization of effort.

Goals are often pursued in the context of social relationships (cf., Fitzsimons, Finkel, & Vandellen, 2015; Fitzsimons & Vandellen, 2015); and the degree to which persons with pain and their friends and family are mutually involved in the pain meaning and pain management process is a question that has yet to be widely or systematically investigated.

Finally, it is essential to recognize that although personal goals are assumed to possess the potential for causal efficacy, they do not function in an operational vacuum, nor should they be expected to unconditionally presage the successful attainment of valued objectives. As Bandura (1997) noted, "a goal is not an agent of its own realization" (p. 122). For their part, control theorists (e.g., Carver & Scheier, 1998; Powers, 1973) have asserted, as noted above, that it is the *perceived mismatch* between desired states (i.e., goals, reference values, or standards) and currently perceived states that serves as the presumptive initiator of action, rather than the

desired goals themselves or the incentives in the immediate environment. For present purposes the message is clear: *Wanting need not imply doing. Doing need not imply achieving.* Therefore, a full appreciation of the significance of goals in human adaptation requires an explicit formulation of their structural nature and functional attributes, of key individual differences in goal-centered thinking, of the contextual challenges and opportunities that shape goal selection over the course of development, and of the cognitive-emotive processes whereby goals are sequentially and episodically propagated toward their completion in a complex, changing, and challenging environment.[2]

1.2.2 Self-Regulatory Processes

Most current formulations posit that goal processes are supported by a distinctly human feed-forward- and feedback-driven *self-regulation system*, whose richly interconnected neural pathways are activated by contextual cues and automatic (bottom up) as well as by self-reflective (top down) mechanisms (Braver, 2012; Carver, Johnson, & Joormann, 2009; de Ridder & de Wit, 2007; Ford, 1987; Karoly, 2010b; Powers, 1973; Woo, Roy, Buhle, & Wager, 2015). Self-regulation operates in the service of goals by means of multiple interacting mechanisms structured to minimize or eliminate current or future challenges to effective goal striving until such time as goal attainment occurs and goal pursuit can be terminated. Thus, once a goal is selected—say, to alter one's diet and eat more nutritious foods, to learn to play the piano, to study for an upcoming examination, or to learn to tolerate daily bouts of low back pain—plans must be formulated, a timeline set, and standards for evaluating progress must be established, among other things. Most of the requisite supportive functions fall under the aegis of a higher-order set of cognitive capacities

2. However, not everyone is in agreement with this view. Some "mechanistic" theories contend that once goals are activated by reward signals, they run off autonomously to completion (e.g., Marien, Aarts, & Custers, 2016).

whose characteristics I have been alluding to and which will receive further explication going forward.

Self-regulation, also known as *self-management* in clinical settings, as *cognitive control* or *executive functioning* in the experimental psychology literature, as *life management* and *effortful control* in life-span developmental research, and as *volition* and *free will* in philosophical circles, is the broad label encompassing the cognitive capacities, or the skill, knowledge, and belief systems that are presumably brought to bear in the service of goal pursuit facilitation.

Unfortunately, self-regulation has proven to be an overly popular term whose multiple meanings are not necessarily interchangeable or equivalent (cf., Burman, Green, & Shanker, 2015). In many ways, the term *self-regulation* has served as an intellectual candy store for theorists and practitioners across an array of psychological disciplines. The idea of human self-directedness—the capacity to transcend the here-and-now—has held great appeal to humanists, cognitive psychologists, psychodynamic clinicians, social psychologists, developmental theorists, and many others. A number of serviceable definitions of self-regulation (a.k.a. cognitive control or other equivalent terms) are currently available, e.g., "The automatic and deliberate processes by which people control and direct their cognitions, emotions, and behaviors in the pursuit of goals" (Barone, Maddux, & Snyder, 1997, p. 303), or "Regulation refers to keeping some controlled process up to some preset criteria, and making necessary corrections when the process diverges from the criteria" (Leontiev, 2012, p. 94). Yet self-regulation can and should be articulated with somewhat greater precision and specificity.

Consequently, self-regulation is here equated with a specific rendering of motivation as viewed within a Goal-Centered, Self-Regulatory, Automated, Social Systems Psychology (GRASSP) model. It is distinct from, but related to, the more traditionally invoked Arousal/Incentive/Invigoration (AII) definition of motivation. Specifically, a GRASSP-based definition of motivation /self-regulation denotes: *those processes (deliberate or automatic, innate or learned, contextually elicited or self-induced) that influence the:* (a) *generation/selection,* (b) *initiation*, (c) *continued*

striving, maintenance, and contextual coordination, and/or(d) termination/disengagement of goal-directed thoughts, situated actions, perceptions, and/or emotions (*the to-be controlled variables or regulatory targets). Self-regulation involves the mobilization of specific skills, resources, and strategic knowledge in response to varied disturbances or challenges*[3] *within and across performance episodes, and is enacted so as to resolve or reconcile disturbances, re-establish coordination among regulatory components [if imbalances occur], and/or forestall future disturbances.* Self-regulatory motivation within GRASSP only becomes operational when well-established action patterns (habits, over-learned responses, or routines) fail to be contextually relevant or to yield their expected effects.

Self-regulation may be contrasted with a close relative, *self-control*, a special case of striving or task engagement that denotes *directional or response probability change in the face of conflicting temporal contingencies* (Kanfer & Phillips, 1970; Karoly, 1995, 2005; Karoly & Kanfer, 1982). Thus, whereas self-regulation involves goal persistence, self-control pertains to goal change. Despite the tendency to conflate these two processes, they remain distinct; although both may be modeled within a GRASSP framework. Specifically, the process of self-control ensues when the immediate consequences of an action are rewarding (e.g., drinking alcohol, ingesting drugs, or tasty but fattening foods) but the long-term consequences are costly (hangovers, addiction, metabolic syndrome), and the resulting conflict usually precipitates an attempt to alter the probability of initiating the problematic short-term action tendency. This situation has been called "delay of gratification." Similarly, actions initially experienced as difficult or aversive (studying, going to the dentist, or tolerating pain), but that possess long-term benefits, likewise require efforts to dampen avoidance and facilitate approach (Kanfer & Karoly, 1972; Kotabe & Hofmann, 2015; Mahoney & Thoresen, 1974). This situation has been called "tolerance of aversive stimulation." Self-regulation and self-control (in both

3. These disturbances or challenges can include mismatch errors, uncertainty, task or role ambiguity, novelty, change, rule transition, stress, conflict, frustration, complexity, emotional arousal, physical illness, and, of course, physical pain (among others).

its manifestations) collectively comprise the basic elements of a broad social-cognitive/control theory perspective on motivation.[4] Moreover, the *self* prefixes in these terms are meant to reflect only that the presumed regulation or control processes are mainly person- or agent-centered, rather than mistakenly implying a transcendental, indwelling causal superstructure that operates apart from situational cues, primes, or contingencies.

The complex processes underlying goal generation, initiation, maintenance and coordination, and/or termination can be resource intensive, consciously mediated, flexible, and extended over time (which I have labeled self-regulation type 1), or they can be relatively effortless, primed (relatively automatic, implicit, or habitual), and extended over relatively shorter time spans (a process I have termed self-regulation type 2). Although many adaptive advantages accrue to the enactment of type 1 self-regulation, it also entails regulatory costs, such as time and energy investment, fatigue, risk of failure, and the gradual decline of reward salience. In a well-orchestrated motivational system, both types of self-regulation should exist in a cooperative, interdependent relationship. Each type has a role to play in the process of goal striving (Braver, 2012; Carver, Johnson, & Joormann, 2009; Karoly, 2012).

The take-home message from the preceding discussion should be clear. In order for goals to function effectively and efficiently as motivational processes with demonstrable causal efficacy, they generally require the supportive scaffolding of self-regulatory course-maintaining and course-correction competencies. These regulatory skills include (among many others) attention and attention modulation, discrepancy or error detection, standard setting, forethought, procedural knowledge, expectancy-value parameters, and the set of processes referred to as executive functions (e.g., working memory, set switching, inhibition, planning, and the like); and they are implemented across multiple analytic levels from the neural to the behavioral to the interpersonal (see Box 1.1 for a listing of representative regulatory mechanisms

4. Note that the control systems or cybernetic perspective occupies a foundational theoretical position within biology, medicine, engineering, mathematics, and other disciplines, in addition to its role in psychology.

Box 1.1 MAJOR PROCESSES/MECHANISMS OF HUMAN SELF-REGULATION

I. PERSON-CENTERED

Information Detection and Processing

- Context- or Ecological Sensitivity /Reality (Source) Monitoring/ Salience Detection
- Sensitivity to Contextual Affordances and Hindrances
- Self-Awareness/Self-Reflection/Self-Monitoring/Performance Monitoring/Interoception/Meta-Cognition
- Social/Interpersonal (Person-focused) Cue Detection & Interpretation (e.g., visual, vocal, auditory information)
- Setting and Use of Self-Evaluative/Self-Appraisal Standards
- Acceptance and Use of Context- and Task-Evaluation Standards
- Social Comparison Processes
- Use of Negative Feedback/Knowledge of Results

Goal-Based Processing

- Goal-Performance Discrepancy Awareness & Appraisal ("Comparator" Function
- Goal Activation/Arousal (Conscious and Automatic Engagement)/ Feed-forward Signaling versus Goal Deactivation/Disengagement
- Goal Setting and Re-Setting (Re-prioritization)
- Goal Framing (Patterns of Goal Appraisal/Reappraisal, Evaluation, Weighting)
- Goal Process Representation
- Goal Episode Schemata, Scenarios, & Scripts (On Line and Off Line)
- Goal Shielding

Strategic Control Mechanisms

- Activation of Expectancy-Value, Attributional-, or Belief-Systems (e.g., self- efficacy; optimism; non-judgmental acceptance)

*Cost-Benefit *Trade-off Analysis* (Ratio of Perceived Payoff to Perceived Effort, Discomfort, Failure Potential, Embarrassment, Financial Investment, etc.)

- Compensatory Thinking; Act-Outcome Justification; Responsibility Engagement/Disengagement
- Attention Modulation (context sensitive; balanced as well as selective)/Vigilance
- Automatic Activation (Up- and/or Down-regulation) of Thought, Action, or Emotion
- Conscious (Intentional) Activation (Up- and/or Down-regulation) of Thought, Action, or Emotion
- Stimulus Control (Active Structuring of the Environment)
- Associative Learning
- Anticipation, Simulation (Foresight; Prospection; Situated Conceptualization; Mental Time Travel; Schematic Thinking; Meta-cognition, etc.), and the Formulation of Accurate Internal Models of the World
- Language Skills & Social Communication Strategies
- Planning
- Inhibition/Suppression/Disengagement of Thought, Action, or Emotion
- Task-Set Switching
- Situational and/or Self-Focused Appraisal and Re-Appraisal
- Dual tasking/Multitasking
- Information & Memory Updating
- Working, Prospective, Procedural, & Autobiographical (Episodic) Memory
- Self-Instruction (e.g., self-talk) & Self-Sanctioning (self-reward/punishment)
- Imagery/Visualization/Imagination
- Recruitment of Instrumental Performance (Motor) Skills
- Vicarious Arousal/Action Imitation (Mirroring)

- Problem Solving/Reflection/Declarative and Procedural Knowledge Deployment
- Contextual Resource Recruitment and Use
- Counterfactual Thinking/Mental Contrasting/Counter-Regulatory Processing Note: The ability and willingness to employ the preceding strategies in a flexible, context-sensitive manner is an important, but often overlooked consideration

II. CONTEXT DEPENDENT

- Direct Tuition/Skill Instruction
- Social Support/External Prompting/Message Framing
- Modeling (Vicarious Arousal)
- Contingencies of External Reinforcement and/or Punishment

III. BODY-CENTERED /NEUROBIOLOGICAL/GENETIC

- Temperament
- Non-associative Conditioning (e.g., Habituation, Sensitization)
- Sensitivity to and Tolerance of Error, Discrepancy, Threat, Conflict, Ambiguity, Uncertainty, Frustration, Distress, Arousal
- The COMT and Serotonin Transporter Gene Polymorphisms
- BIS/BAS (Approach/Avoidance) Systems
- Vagal Tone
- Epigenetic Processes
- Prefrontal Cortex, Anterior Cingulate Cortex, Amygdala Activation
- Default Mode Network
- Brain Network Connectivity
- Executive Functions (see the *Person-Centered* listings)

across three analytic levels). Although goals do not unilaterally "drive" or impel self-regulatory activity, different types of goals (e.g., simple versus complex, single versus multiple, short term versus long term, approach versus avoidant) are presumed to elicit different types of self-regulatory support.

Moreover, although no universal prescriptive formula exists that articulates which self-regulatory processes are necessary and/or sufficient for the achievement of any given goal, a half dozen core or minimal components can be derived from social-cognitive/control theory. These include: mismatch-, discrepancy awareness, self-observation, goal (standard) setting (the feed-forward function), goal-performance discrepancy appraisal (the comparator function), evaluative and tangible self-reactions (such as self-cueing and the provision of incentives), and discrepancy correcting instrumental and communicative skills. Of course, the utility of any of the mechanisms listed in Box 1.1 hinges upon their level of instrumental effectiveness; when, why, and how they are recruited (i.e., their timing, justification, and situational relevance); the actor's subjective appraisal of the costs and benefits associated with their use; situation-specific structural barriers to their use and random or unpredictable fluctuations in targeted task requirements. Regrettably, such indeterminate modulating factors, which serve to infuse a measure of flexibility into the system, are largely overlooked in the design of "one-size-fits-all," non-tailored, non-responsive intervention programs designed to modify self-regulation/self-control problems.

It is also important to bear in mind that, just as goals are dependent upon self-regulatory facilitation, *self-regulatory operations are also goal and setting dependent*. Thus, seeking to describe either a "failure" or "success" of self-regulation without specifying the task-relevant goals is roughly equivalent to criticizing or praising an actress's authenticity in a performance without any reference to the nature of the role she was assigned to play. Piehler and Dishion (2014), for example, described a situation in which the external circumstances appear to determine whether self-regulation does or does not operate in a functional manner. Specifically, these authors point out that when adolescents live among few deviant peers, adolescents' strong self-regulatory skills are protective. But when surrounded by many deviant peers, these same self-regulatory competencies are deemed to be risk inducing. Why should this be? A fuller rendition of the apparent power of the social context follows from the assumption that when adolescents equipped with well-developed self-regulatory skills become close friends with law-abiding peers, they employ their regulatory skills to

enact pro-social goals. Alternately, when they befriend deviant peers, they use their skills in pursuit of peer-approved, anti-social goals. Hence, the nature of the goals being regulated in a specific context that provides the explanatory pivot point.

Because goals can justifiably be considered to be the products of the larger culture, both goal pursuit and self-regulatory processes should be considered to be *embedded* motivational processes. That is, they operate in concert with supportive (and sometimes disruptive) interpersonal and structural contextual affordances as well as being subject to societal imperatives. Likewise, from a bottom-up perspective, the enactment of goals and self-regulatory capacities depend upon neural systems as well as genetic and biological predispositions (e.g., temperament and perceptual sensitivities).

Summarized in its most basic form, a motivational systems analysis suggests that

> *Effective Human Goal Directedness = (f) Goal Systems + Self-Regulatory Competencies + Contextual Affordances + Biogenetic/Neural Supports*

Figure 1.1 illustrates the basic components involved in the self-regulation process and its regulatory targets. Goals and goal episode processes are set at the center of nine component constructs that include self-regulatory strategies and executive competencies, instrumental skills, arousal mechanisms, knowledge and memory systems, beliefs and values, automatic processes, and the capacity to anticipate and simulate the future (Box 1.1 provides content specific exemplars of mechanisms operating within these nine domains). Limiting and enabling conditions occurring at the socio-cultural, biogenetic, and developmental levels serve to ground and contextualize the model.

Also, inasmuch as conceptual accounts necessarily lean upon meta-theoretical premises, the underlying philosophy of the GRASSP approach may be succinctly captured by the following guiding principles:

- Humans are viewed as self-regulating systems actively involved in the everyday enterprise of living.

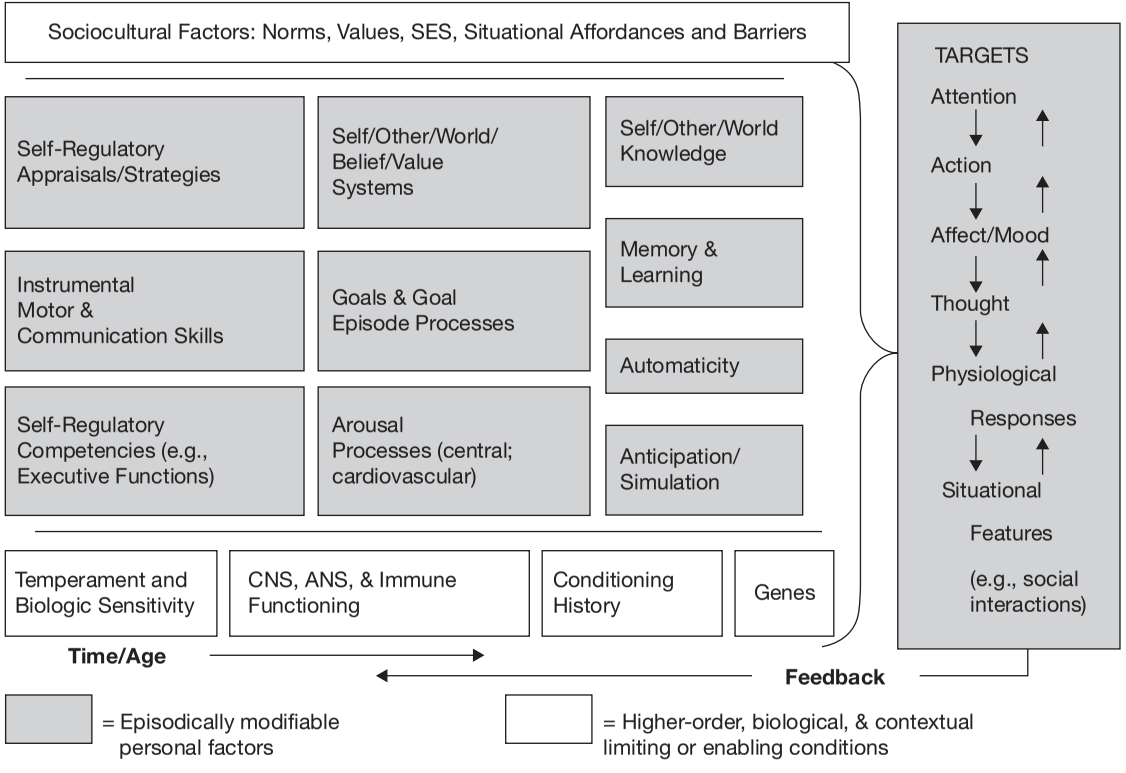

Figure 1.1 Descriptive model of self-regulatory components and targets.

- Humans are goal-directed and error sensitive to varying degrees across various contexts.
- Behavior, thought, and emotion occur during the course of time-and-setting-bound *goal episodes*.
- Humans maintain and transform their experiences through the symbolic and sub-symbolic processing and manipulation of information.
- Goal directedness reflects evolved biogenetic substrates, dynamic neural supervisory mechanisms, and contextual constraints, as well symbolic and sub-symbolic operations.
- People display consistencies in their dynamic patterns of perceptual, cognitive, behavioral, emotional, and transactional variation in response to situational cues, contingencies, opportunities, barriers, threats, conflicts, and barriers under the aegis of goals and self-regulatory competencies.
- The fundamental causal determinants of "motivation" are goal (feed-forward) processes in interaction with environmentally or internally activated discrepancy/error/change detection functions that trigger anticipatory and retrospective schemas (mindsets, simulations, narratives) and momentary micro-level preparatory and compensatory responses that, when supported by feedback, contextual affordances, self-regulatory skills, and biogenetics, foster the process of striving but do not guarantee its ultimate success.
- Perception, action, emotion, and cognition are interconnected and intrinsically linked to goals and to various modes of goal framing.
- Goal-relating thinking and self-regulatory processes are the motivational bridge between everyday negative experiences (e.g., stress, fear, or pain) and adjustment outcomes—both adaptive and maladaptive.
- Maladjustment, in both the somatic and mental domains, reflects situationally induced or physically induced dysfunctions or imbalances in life-goal striving. Such dysfunctions represent

failures in the self-regulated processing of emotions, thoughts, perceptions, and/or actions. Symptoms (disordered patterns of thought, feeling, action, or perception) are maintained by goal-centered compensatory and justificatory operations.

- Motivation is never an "either-or" phenomenon (either switched on or off, conscious or unconscious, internal or external, grounded in the past, the present, or the future). Rather, motivation involves multiple interacting mechanisms unfolding continuously in real time and sequentially coordinated in a hierarchical system. Even presumably "unmotivated" people pursue goals and endeavor to regulate them.

1.2.3 The Intersection of Self-Regulation and Chronic Pain: Prior Models

As a heuristic for appreciating the motivational contours of chronic pain, an earlier rendering (Karoly & Jensen, 1987), suggested that the human pain experience could profitably be viewed as a goal-directed process, one that is "internally regulated in a closed loop system organized so that the flow of information within in serves the purpose of keeping momentary input within the range of a preset (but not invariant) standard" (Karoly, 1985, p. 484). Subsequently (Karoly,1988), recurrent pain was articulated as an *information control/action system* (a.k.a. a self-regulating system) and was further fleshed out, including a listing of key processing mechanisms such as attention modulation, error detection, self-monitoring, memory and learning, inhibition, anticipation, and self-cuing (among many others).Yet, because much of the early discussion was couched in terms of pain *assessment* rather than as a general recasting of the pain adjustment process, the control theory account failed to gain much traction within the clinical or research community. Fortunately, the growing popularity of control systems (or cybernetic) models of self-regulation across diverse domains such as personality, social, health, applied, and clinical psychology (Bandura, 1986, 1997; Boekaerts, Pintrich, & Zeidner, 2000;

Carver & Scheier, 1990; Emmons, 1999; Ford, 1987; Higgins, 1987, 1996; Karoly, 1993a; Lord & Levy, 1994; Pervin, 1989) has led to a greater acceptance of motivational constructs (albeit no single motivational model) in the pain literature.

Although several accounts of pain phenomena have appeared that invoke the umbrella term "self-regulation," in these accounts self-regulation typically assumes the role of a stable, between-person action tendency (e.g., a temperament- or coping style) rather than reflecting the interdependent operation of a set of regulatory components, process mechanisms, and biosocial boundary conditions (cf., Ford, 1987). For the most part, these accounts have not been concerned with the sequential unfolding of motivational processes. And, although touching on various failures of self-regulation, they have not strongly emphasized the pivotal role of goals or goal pursuit processes as potential contributors to regulatory failures. Likewise, 30 or 40 years ago most behaviorally inspired work on pain self-regulation drew upon highly structured, experimenter-controlled biofeedback or relaxation techniques (e.g., Varni, 1981), with only scant attention paid to participants' unfolding goal striving trajectories. In sum, contemporary "self-regulation" modelers have frequently sought to exploit specific motivational components, often articulated as traits, states, beliefs, behavioral skills, or predispositions, whose relation to pain adaptation and/or disability has been gauged almost exclusively at the between-person level.

Jensen, Nielson, and Kerns (2003), for example, recognizing that pain patients need to assume responsibility for their treatment, underscored the need to enhance the state of readiness to engage in requisite coping activities. For these authors, "self-management" (their equivalent of self-regulation) is an outcome (rather than a process) consisting of a set of coping strategies such as pacing, relaxation, task persistence, etc. that are set in motion by a readiness-to-change disposition which, in turn, is said to depend upon two primary antecedent beliefs: self-efficacy and perceived importance. Solberg Nes and her colleagues (Solberg Nes, Carlson, Crofford, de Leeuw, & Segerstrom, 2010; Solberg Nes, Roach, & Segerstrom, 2009) employ the term "self-regulation" to refer both to directional maintenance and to directional change (what I would call

self-control), while emphasizing the importance of factors that may serve to tax or deplete regulatory resources. For their part, Sauer, Burris, and Carlson (2010) emphasized the role of *self-control skills* in the management of some of the physiological facets of fibromyalgia.

Finally, Leventhal and his colleagues (e.g., Leventhal, Zimmerman, & Gutmann, 1984) have for decades addressed self-regulation as it pertains to chronic illness management as well as its role in pain (Detweiler-Bedell, Friedman, Leventhal, Miller, & Leventhal, 2008; Hobro, Weinman, & Hankins, 2004). Leventhal's classic work on the *common sense model of self-regulation* (e.g., Leventhal, Brissette, & Leventhal, 2003) pivots on understanding and influencing patients' schemas or *illness representations,* their emotional reactions to their illness, and the effects of illness cognitions on medical compliance. Notably, Leventhal was among the first to recognize that a control theory perspective highlights the patient's subjective model of illness and the nature of model-generated goals (reference signals) that can serve to either facilitate or hinder the self-regulation of treatment adherence and other health-related behaviors (cf., Karoly, 1993b). Later, I shall reiterate the clinical importance of patients' schematic representations, specifically those that address goal- and pain-related internal models, scripts, and simulations.

Each of the aforementioned perspectives spotlights important social-cognitive factors in pain adaptation, highlighting the strategic use of expectancies, values, attributions, and related cognitive-motivational processes. These conceptions complement the GRASSP approach that expressly highlights goals and their supportive mechanisms as focal components.

1.3. CHRONIC PAIN, GOAL COGNITION, AND SELF-REGULATION: TRACING PAIN'S MOTIVATIONAL SIGNATURES

Specific goal and regulatory constructs and their links to chronic pain adaptation are addressed next. I shall illustrate how pain, as a body-centered

idiom of distress, can undermine self-regulated goal pursuit (usually articulated as dysfunctions in short- and long-term task performance as assessed in both laboratory and natural settings). Because supportive anecdotal and empirical evidence for this motivational disruption is scattered across diverse literatures (e.g., Arntz & Hopmans, 1998; Karoly & Ruehlman, 2007; Poulin & Heckhausen, 2007; Van Ryckeghem, Crombez, Eccleston, Liefooghe, & Van Damme, 2012; Waehrens, Amris, & Fisher, 2010), the present section focuses mainly on a delineation of when and how (and not just whether) pain tends to produce deleterious cognitive-motivational effects such as functional disability, behavioral avoidance, and task disengagement.

The overarching aim of this section is to demonstrate that goal-centered self-regulatory processing contributes in significant ways to chronic pain adjustment. From a GRASSP perspective,

> *chronic pain is believed to produce its most salient and lasting negative effects on the enterprise of living by virtue of its cumulative impact upon the sequential, day-to-day unfolding of goal-related thinking, feeling, and striving as well as upon the individual's capacity to recruit self-regulatory skills and strategies (e.g., attention modulation, inhibition, anticipation, self-efficacy beliefs, problem solving, and the like) in the service of goal directedness.*

Because the reader will find extensive discussions of several key goal and self-regulatory motivational concepts in other chapters of this volume, the coverage here will not deal with the role of attention and attention capture (Chapter 7), avoidance and persistence (Chapter 8), or goal conflict and frustration (Chapter 11). Rather, in this section maladaptive goal cognition will be explored by examining how persons with chronic pain differ from non-pain controls in terms of goal framing, goal schemas, goal striving processes, and executive (self-regulatory) functioning.

The reader should also take note that investigators have employed various methods for sampling the goal-related thought content of persons with pain, culling a variety of themes and arranging their contents into

different subcategories. Among the more common subtypes of goals are those that pertain to medical or pharmacologic remediation (i.e., managing or eliminating the pain), pain avoidance, interpersonal relationships, vocational pursuits, self-improvement, improved sleep, access to social support and nurturance, improved mobility, reduction of fear and anxiety, and alterations in prescription and non-prescription medication use (the desire to either increase or decrease drug taking). Yet, generally speaking, *what people want(goal content)*, although descriptively valuable, is less likely to differentiate one person from another or to serve as a diagnostic or prognostic marker than *how people want*—that is, their manner of goal appraisal and self-regulatory processing.

1.3.1 Goal Framing and Goal-Process Thinking

Several studies have, for example, shown that persons with recurrent pain tend to articulate their goal evaluations (i.e., their recurrent patterns of goal appraisal or goal framing) or their goal process thinking (see the discussion of the GSAB later in this section) in ways that differ from how persons free of pain construe their goals. Moreover, ostensibly maladaptive styles of goal- and pain-relevant mental processing in turn contribute to (or are correlated with) adverse outcomes such as perceived disability and impairments in subjective well-being. Conversely, persons with "healthier" patterns of goal-related thinking are believed to fare better. Hence, whereas pain readily captures attention and appears to directly undermine goal-directed action and thought, individual differences in the subjective process of pain and goal construal can serve to exacerbate or mitigate pain's often deleterious effects.

For example, Vroman, Chamberlain, and Warner (2009) employed Little's (1983) personal project analysis (PPA) methodology to gauge how patients with low-back pain evaluate their medium-range goals (a.k.a. *personal projects*). Participants, recruited from various health care facilities, provided their five most important goals and then appraised them along several basic PPA goal evaluation dimensions, including perceived

difficulty, stressfulness, enjoyment, and control, as well as a set of pain-specific dimensions such as whether the chosen goals cause pain and whether pain interferes with the pursuit of each goal. The 26 total rating dimensions were factor analyzed and the factor scores then correlated with clinical indices such as satisfaction with life and functional status. The PPA factor labeled *Stressfulness* correlated inversely with life satisfaction, inversely with SF-36 measures of physical function and disruption of emotional roles, and positively with depression. The factor labeled *Pain Salience* showed similar patterns, but also varied inversely with SF-36-defined disruptions of physical roles and social functioning.

Crombez, Lauwerier, Goubert, and Van Damme (2016) employed the PPA method to better understand why some people show rigid motivational patterns (getting "stuck in attempts to control pain") by specifically comparing *pain control* goals to other pain-related goals in a group of 73 adult Dutch pain patients. Participants were encouraged to freely list all their current goals but were also requested to include at least one goal that centered on pain control. They were then asked to select their two most important non-pain control goals and their most important pain control goal and then rate these along such standard PPA dimensions as: importance, difficulty, control, stressfulness, time spent, progress, self-identity (e.g., "This goal says a lot about who I am"), and value. The participants also rated the extent to which the three chosen goals interfered with or facilitated each other and completed a set of questionnaires tapping pain acceptance, engagement in pain solutions, meaningful of life, and pain catastrophizing. Among the interesting findings were: that pain control goals were provided spontaneously by only 40% of the sample, that the pain control goal was perceived as more difficult, stressful, and time intensive and as less representative of self-identity compared to non-pain control goals. In addition, participants engaged in finding solutions to their pain reported more difficulties in attaining their non-pain goals. Thus, pursuing a pain control goal can be a difficult and frustrating undertaking with the potential to derail normative pursuits.

The Goal Systems Assessment Battery (GSAB; Karoly & Ruehlman, 1995) is a set of four instruments designed to assess key appraisals not

of goals per se, but of the goal pursuit process (Ford, 1987; see also section 1.2.1). The Directive Function Questionnaire gauges goal-relevant self-efficacy and value. The Regulatory Function Questionnaire taps self-monitoring of goal activity and social comparison processes. The Control Function Questionnaire assesses goal planning, self-reward, and self-criticism. And the Arousal Function Questionnaire measures self-reported positive and negative arousal during goal pursuit. Investigators (e.g., Affleck et al., 1998; Affleck, Tennen, Zautra, Urrows, Abeles, & Karoly, 2001; Karoly & Lecci, 1997; Karoly & Ruehlman, 1996) have consistently found that how people think about their goal processes, as measured via the GSAB, predicts multiple facets of pain adjustment and aspects of mental health.

For example, Karoly and Ruehlman (1996) gathered data from a national sample of adults in management positions, inquiring about their pain experience, their work-related goals, and current adjustment (depression and anxiety). Participants with chronic pain (moderately intense pain for 6 months or more), episodic, but non-persistent pain of low intensity, and no pain provided answers to the four questionnaires comprising the GSAB, with scores averaged across their two most important vocational goals.

Individuals with both persistent and episodic pain differed from their non-pain peers in their appraisals of the goal process as reflected in their GSAB sub-scores. Specifically, the two pain groups reported lower levels of goal value, goal-related self-efficacy, and positive arousal relative to the non-pain group as well as higher levels of goal-specific self-criticism, negative arousal, and conflict between their work and non-work goals. Moreover, GSAB-assessed goal cognition accounted for unique variance in depression and anxiety after accounting for pain severity.

The Directive Function Questionnaire of the GSAB was used by Affleck et al. (2001) in a diary study of women with fibromyalgia. For 30 days participants rated the value and self-efficacy associated with a self-selected health-and-fitness goal and a self-selected social relationship goal, and three times per day they rated their pain and fatigue levels in response to palm-top computer queries. In addition, each night before bedtime,

the women rated (among other things) their goal effort, goal progress, and goal barriers due to pain and fatigue. These investigators found that GSAB-ratings of goal value and goal self-efficacy were related to the ongoing pursuit of social and health goals as well as to the rising and falling levels of daily pain. Specifically, goals valued more highly were found to be pursued more effortfully and successfully. On days with greater than average pain and fatigue, less progress was reported on both goals as well as more pain- and fatigue-based barriers to goal accomplishment. Of the two types of goals, health-related goals appeared to be more difficult to attain.

1.3.2 Pain and Goal Striving: GRASSPing Goal Dynamics

In our laboratory, my colleagues and I have investigated chronic pain's effects upon the pursuit of goals (work-related and interpersonal) using traditional between-group comparisons (e.g., Karoly & Ruehlman, 1996; Karoly, Ruehlman, & Okun, 2013: Ruehlman, Karoly, & Newton, 2005). In addition, we have conducted within-person analyses based on data collected via daily diaries. The value of having persons with pain provide information several times per day about their level of pain, their progress on one or more goals, their affective experiences, and related parameters is that such an intensive longitudinal procedure permits a fine-tuned, ecologically meaningful process analysis of what may be termed *pain dynamics* (cf., Shiffman, Stone, & Hufford, 2008; Wickham & Knee, 2013). The term "dynamics" is expansive, denoting several distinct variations in the goal striving process, including (but not limited to) within-person changes in the selection, appraisal, planning, pursuit, revision, resumption, shielding, or switching of goals as well as the influence of such coactive self-regulatory operations as emotion modulation, self-monitoring, performance-contingent self-presentation of reward or punishment, sensitivity to success and failure feedback, level of action identification, and other regulatory parameters. The effect of individual differences (between-person measurements) on the flow of events is also capable of being modeled.

Illustratively, the temporally extended pathway from the experience of pain and affect in the morning to pain's interference with the pursuit of a work goal in the afternoon and finally to perceptions of work goal progress in the evening was examined in a diary study by Mun, Karoly, and Okun (2015). The within-person relationship between the intensity of morning pain and evening goal progress was hypothesized to be mediated by pain's interference with the pursuit of a work goal in the afternoon. In addition, the expected positive relationship between morning pain intensity and pain's interfering effect on the afternoon work goal was hypothesized to be moderated by a set of presumably stable person variables: catastrophizing and pain acceptance. Morning positive and negative affect were also predicted to yield direct effects on pain's interference with goal pursuit in the afternoon. The study's findings supported the mediational prediction, yet revealed that only pain acceptance (but not catastrophizing) acted as a moderator. High levels of pain acceptance served to attenuate pain's disruptive effects and morning positive affect was inversely related to pain's interference with work goal pursuit in the afternoon.

By employing diary methods, within-person processes can be employed to examine other motivational outcomes as well. For example, Okun, Karoly, Mun, and Kim (2016) sought to understand factors relating to *work goal resumption* occurring later in the day after individuals with chronic pain had indicated that their non-pursuit of a work goal on a particular day was due to their pain. The link between perceived pain-based interference/interruption and later work goal resumption was hypothesized to be mediated by the individual's affective reactions to the non-pursuit of the work goal. In this study, participants' attributions for work-goal non-pursuit were assessed in the afternoon along with measures of pain intensity, stress, positive and negative affect (the PANAS scales), and ratings of how disappointed and frustrated participants were about not pursuing their work goal.

Findings revealed that on days absent goal pursuit in the afternoon, increases in pain-related interference attributions were positively associated with negative affective reactions (frustration and disappointment) that were, in turn, associated with an *increased* likelihood of same-day

work goal resumption. Given the interest among applied psychologists in managing work flow in vocational settings, investigating the role of pain and pain-related emotions and cognitions over time would appear to offer unique insights about a sizeable albeit neglected population of employees. Apparently, negative affect born of pain-related interference increased the likelihood of goal resumption—a seemingly counterintuitive finding, but one consistent with a control systems model wherein negative emotionality can act as a signal to mobilize one's efforts toward approaching a desired outcome. Although replication of such a finding is needed, the study nonetheless illustrates how extended within-person investigations of goal striving and pain can adduce both expected and unexpected findings.

1.3.3 Pain and Compromised Executive Functioning

Chronic pain's potentially adverse impact upon an array of cognitive domains has been and continues to be widely studied (Moriarty, McGuire, & Finn, 2011). Of particular significance to the present review is whether pain produces impairments in the operation of executive functions (EFs), a loosely connected set of competencies believed to be localized in the prefrontal cortex, and originally (Lezak, 1983) said to include goal formation and setting, goal-directed planning, goal-directed action, and effective performance but, in recent years, was expanded to cover a larger assortment of skills such as attention control, set switching, inhibition, updating, and other aspects of volition (Barkley, 2012; Jurado & Rosselli, 2007; Solberg Nes, Roach, & Segerstrom, 2009). Notably, EFs are very well represented among the self-regulatory processes listed in Box 1.1. Consequently, the question of whether and how chronic pain may compromise key aspects of distinct executive competencies fits within the purview of this chapter. And consistent with Barkley (2012), we can consider each component of executive functioning to be a type of self-regulation.

Several reviews (Berryman et al., 2014; Solberg-Nes, Rosch, & Segerstrom, 2009) suggest that because EFs are difficult to define and do

not constitute a unitary system, any straightforward conclusions about pain's tendency to impair or compromise them must be drawn cautiously. With that caveat in mind, it seems fair to conclude from the published reviews that those components or self-regulation that tap into the goal-based processes already noted and presumably operating under the aegis of the prefrontal cortex can, under certain conditions, be undermined to measurable albeit modest degrees by the everyday experience of pain. Perhaps the major stumbling block in appreciating the precise nature of pain's challenge to executive competencies derives from the variation in the measurement operations employed to gauge the selected EFs.

For example, Baker, Gibson, Georgiou-Karistianis, Roth, and Guimmarra (2016) administered a 75-item self-report measure, the Behavior Rating Inventory of Executive Function, Adult version (BRIEF-A) that assesses nine executive competencies (inhibition, shifting, emotional control, self-monitoring, task initiation, working memory, planning, task monitoring, and organization) to 66 Australian pain patients with an average pain duration of 9 years and to 66 pain-free, age- and gender-matched controls. Whereas the pain group differed from the controls on all nine BRIEF-A scales (reflecting poorer executive abilities), within the pain sample, the profile of scores showed some variation—with almost 50% of patients showing clinical levels of elevation on set shifting, emotional control, task initiation, and working memory. Working memory and emotional control were the two most prominent areas of impairment. Thus, it would appear that pain undermines a number of important self-regulatory competencies—some more strikingly than others.

However, when neuropsychologists and experimentalists assess executive functioning, they typically utilize performance measures rather than self-report indicators. To assess inhibitory ability they might employ a Stroop task. To measure set switching they could make use of the Wisconsin Card Sort. Still other researchers have sought to gauge executive function activity at a neural level. Thus, it would appear advantageous for investigators of executive function in pain to employ self-reports of ecologically meaningful goal guidance actions, performance based indices, and brain-based assessments. Unfortunately, this multi-method approach

has yet to be enacted. Lacking data from a combined analytic assault on pain's effects on executive skills, we can nonetheless inquire as to whether neuropsychological and neural measures yield findings similar to those just reported.

Pulles and Oosterman (2011), for example, administered tests of memory performance, mental processing speed, and several traditionally defined executive skills, the Stroop test, the Trail-Making test, and a verbal fluency test (generating words beginning with a specific letter as fast as possible), to a small group of pain patients from physical therapy clinics in the Netherlands. They also examined the relationship of these performance measures to indices of pain intensity, physical functioning (e.g., grip strength, a walk test), and self-reported physical and psychological functioning. The results showed that pain was significantly related to mental processing speed, but not to memory or to any of the executive functioning tests. Whereas pain and executive functioning did not appear to be strongly linked in this study, the small sample, the absence of a control group, and the relative youthfulness (average age under 50) of the participants warrants a cautious interpretation. By contrast, Glass et al. (2011) compared persons with fibromyalgia to a healthy control group on a test of response inhibition (a Go/No-Go task) while the participants underwent an fMRI. No differences were found between the pain group and the controls on the response inhibition (executive) task, although the fMRI indicated lower activation in the inhibition and attention networks of the brain for the fibromyalgia patients. Thus, the pain-executive function connection in this study emerged at a neural, but not at a behavioral level. On the other hand, in a study designed to evaluate the relationship between social cognition and executive functioning in persons with fibromyalgia, DiTella, Castell, Colonna, Fusaro, Torta, Ardito et al. (2015) reported that their fibromyalgia group performed significantly less well than their control group on tests of updating, set shifting, inhibition, and verbal fluency, thereby supporting an executive function deficit among persons with fibromyalgia.

Although the Berryman et al. (2014) meta-analysis suggests that moderate impairments in executive skills are associated with chronic pain conditions, it should be obvious that more work needs to be done to

address contextual and methodological issues. More diverse (less biased) samples of pain conditions, incorporating not only larger numbers of pain patients and healthy controls but assessments of potential moderators of executive performance (age, gender, health status, medication status, etc.) and multiple measurement operations would clearly be beneficial. Also important is the acknowledgment that standard cognitive performance-based indices of executive function are not "process pure"—that is, that the accuracy and reaction time measurements they engender are influenced by multiple factors in addition to the named skill that is purported being addressed. In a noteworthy review, Toplak, West, and Stanovich (2013) pointed to the very real possibility that self-report and performance measures of executive function are tapping different psychological constructs. Appraising 20 studies in which self-report and performance measures were included, these authors found a median correlation of 0.19 between them. Intriguingly, they postulated that the lack of convergence could be because these approaches are tapping different levels of cognition—an "algorithmic" level, reflecting brain-based information processing mechanisms (for performance measures) and a "reflective" level, tapping the individual's goals, goal appraisals, goal-based beliefs, and the specific action strategies chosen for goal attainment (for self-report measures). The authors assert that performance indices, although gauging the efficiency of mental processing, "bypass the whole issue of rational goal pursuit" (pp. 137–138). These ideas possess obvious implications for the study of pain and executive functioning, and for the relevance of the goal-based model that has been outlined in this chapter.

1.4. GOALS AND SELF-REGULATORY PROCESSES CAN FACILITATE ADJUSTMENT IN THE FACE OF CHRONIC PAIN AND OTHER AVERSIVE/CHALLENGING EVENTS

Real world goal striving is complex and fraught with difficulties under normal circumstances. When chronic pain is added to the equation, the

burden on the individual can be daunting because, in the absence of medical cures, many pain disorders require life-long management and adjustment. Having considered how pain undermines the goal-centered, regulatory process, it is now time to examine some motivational buffers or pain moderators. Despite pain's capacity to undermine goal-directedness, data exist suggesting that certain goal based and self-regulatory operations might be capable of facilitating flexible responding to unpredictable distress, change, or novelty, thus protecting the individual's aspirational agenda, engendering stress resilience, facilitating a balance between goals and contextual opportunities and barriers, and promoting a robust level of engagement with the day-to-day enterprise of living—even in the face of pain. Although my purpose here is not to review systematic pain treatments per se (but see Section III of this volume), some of the processes whereby persons with pain can overcome, ameliorate, or soften the myriad motivational barriers to healthy functioning can be highlighted.

1.4.1 Flexible Goal Management and Goal Adjustment

The work of Arends, Bode, Taal, and Van de Laar (2013, 2016) has addressed the important question of how people with polyarthritis (including rheumatoid arthritis, ankylosing spondylitis, and psoriatic arthritis) manage their goal pursuits in the face of various interfering symptom expressions. Basic learning and control-system models would suggest that people should use performance feedback to adjust or recalibrate their actions and expectancies. Although chronic pain may weaken an individual's use of normal, feedback-driven cognitive heuristics, certain goal management strategies—including the willingness to abandon previous pursuits and develop new goals or lower performance standards—may assist in the process of adjustment along with efforts to stay committed to prior goals. From a control theory perspective, then, goal management strategies are the action functions intended to reduce or minimize perceived discrepancies between goals and current attainments.