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An Integrated Biopsychosocial Model of Automaticity, Allostasis, and Addiction and a Rationale for MORE

Addiction remains all too commonplace despite a century of intervention efforts, and it is often intractable to existing treatments. Relapse following treatment is the norm, and long-term recovery rates are low. For example, in the case of alcohol dependence, according to the National Epidemiologic Survey on Alcohol and Related Conditions, 28 percent of people ever treated for alcohol problems remain dependent on alcohol, and 19 percent continue to exhibit alcohol abuse or subclinical dependence symptoms over the past year (Dawson, Grant, Stinson, et al., 2005). From such statistics, it is apparent that there is a large subset people recovering from addiction for whom available addictions treatments are largely ineffective. What might account for the insufficiency of existing treatments? The majority of extant psychosocial interventions for substance dependence (for example, motivational interviewing, cognitive–behavioral therapy, 12-step programs) target conscious decision-making and motivational processes. Yet two decades of research from neurobiology and cognitive neuroscience have revealed that addiction is largely mediated by the activation of brain structures that operate beneath consciousness. These brain structures appear to control automatic, habitual behaviors—behaviors that can be activated, without willful intent, by stress and negative emotion (Dias-Ferreira et al., 2009; Schwabe, Dickinson, & Wolf, 2011). In this chapter, I review current scientific literature to describe a pathway by which stress influences addiction. This pathway involves positive feedback loops between stress, cognitive appraisal, emotion dysregulation, physiological arousal, implicit cognition, and palliative coping with substances. Insofar as MORE was designed to target each one of these addiction risk factors, understanding this stress-precipitated risk chain is necessary for the effective implementation of MORE.

Stress is a key risk factor that maintains addiction and promotes relapse. For example, stress predicts heavy and more frequent alcohol consumption; drinkers who reported experiencing six or more stressful life events consumed more than three times the amount of alcohol each day and drank heavily three times more frequently than did people who had not experienced life stressors in the past year (Dawson, Grant, & Ruan, 2005). Each experience of a past-year stressful life event increased the frequency of heavy drinking by 24 percent for men and 13 percent for women, and increases in stress were associated heavier patterns of alcohol consumption (Dawson, Grant, & Ruan, 2005). In addition, experiences of stressful life events in childhood cumulatively predict the onset of alcohol dependence during adolescence and early adulthood (Lloyd & Turner, 2008). In a similar manner, a host of studies indicate that adolescents facing negative life events show elevated levels of drug use and abuse (for a review, see Sinha, 2008), and young adults who experience a greater accumulation of adverse and traumatic events over their lives are at greater risk for developing drug dependence (Lloyd & Turner, 2008). Moreover, drugs and alcohol are often used to "self-medicate" the unpleasant emotions and distressing physical reactions of the stress response (Garland, Pettus-Davis, & Howard, 2012; Khantzian, 1997). Recovering addicts commonly report that relapse is precipitated by episodes of stress and negative emotion (Marlatt & Gordon, 1985). Thus, epidemiological research and clinical anecdotes strongly suggest that stress is central to addiction.

This chapter describes a new iteration of a conceptual model that my colleagues and I first published elsewhere (Garland, Boettiger, & Howard, 2011; Garland & Froeliger, in press), integrating theory and research findings on stress, cognitive processes, and addiction to explain how drug and alcohol dependence is maintained and reactivated by stressful life events. The integrative model proposed has been influenced by a number of well-known theoretical frameworks, including the transactional model of stress and coping (Lazarus & Folkman, 1984); the allostatic model of addiction (Koob & Le Moal, 2001, 2008); the cognitive processing model of craving and compulsive alcohol use (Tiffany, 1990); the affective processing model of negative reinforcement (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004); and the second-order cybernetic model of stress, metacognition, and coping (Garland, 2007). In brief, repeated use of alcohol and drugs establishes the automatic habit of substance use that drives the continued consumption of psychoactive substances, even in the absence of conscious intent (Tiffany, 1990). However, when addicts in recovery exert conscious effort to resist the temptation to use drugs and alcohol, this attempted suppression amplifies the experience of craving (Tiffany & Conklin, 2000). In turn, stress and negative emotions evoke these automatic and conscious cognitive processes underlying addiction, increasing the drive to use drugs and alcohol as means of palliative coping (Olff, Langeland, & Gersons, 2005). Stress coping via substance use is then sustained through negative reinforcement conditioning (Baker et al., 2004); in other words, self-medication with psychoactive substances temporarily relieves distress, which then strengthens and promotes the habit of using drugs and alcohol to cope. Continued operation of this self-perpetuating cycle, which may be conceptualized as a feedback loop, leads to an ever-deepening cycle of addiction fueled by an increasingly heightened sensitivity to stress.

Here, I first detail this integrated conceptual framework to describe pathways between the experience of stress and the compulsive consumption of psychoactive substances. Next, this conceptual framework is used to ground a discussion of how and why MORE can ameliorate stress and addiction.

AN INTEGRATED BIOPSYCHOSOCIAL FRAMEWORK FOR STRESS-PRECIPITATED ADDICTION MAINTENANCE AND RELAPSE

The etiology of addiction is complex and multifactorial, involving interactions between genetic, environmental, biological, psychological, and social forces. Over time, as consumption of alcohol and drugs becomes addictive, automatic drug use habits begin to supersede controlled, volitional use. Once addiction is established, self-control becomes hijacked by the addictive process, and consumption of alcohol and drugs continues in spite of the willful intent to remain sober. Even repeated and severe consequences such as loss of a spouse, termination from a job, and problems with one's health or the legal system may not be enough to discourage the addict from further use. Furthermore, the threat of future consequences is often insufficient to prevent relapse.

How does stress promote the process whereby the addictive impulse undermines the conscious intent to abstain from drugs and alcohol? In response to this question, the following the integrated framework is offered. Note that this framework describes an informational circuit in which the causal flow loops back on itself, with the output of the circuit (that is, relapse) becoming its own input (that is, a stressor) in further iterations of the cycle. This cybernetic circuit is depicted in Figure 1 (see also Bateson, 1972), which is discussed in the text that follows. The framework details a network of processes that may not, in actuality, progress in a linear, stepwise fashion. More likely, these processes are interdependent and operate in a recursively and holistically. Yet, to facilitate comprehension, each stage of the risk chain is numbered and presented sequentially.

1. Cognitive Appraisal of the Stressor Activates the Risk Chain

Stress is a multicomponent process, not a monolithic concept. Unlike inorganic objects that deform predictably and systematically under the load of an external force, humans actively (albeit unconsciously) construct their own experience of reality out of the encounter with the environment according to their own self-organization (Maturana & Varela, 1987). In other words, people do not perceive some objective reality but, rather, perceive the world according to their own cognitive structures and processes (Lewis, 2001). For example, when reading this book, you do not perceive a four-dimensional

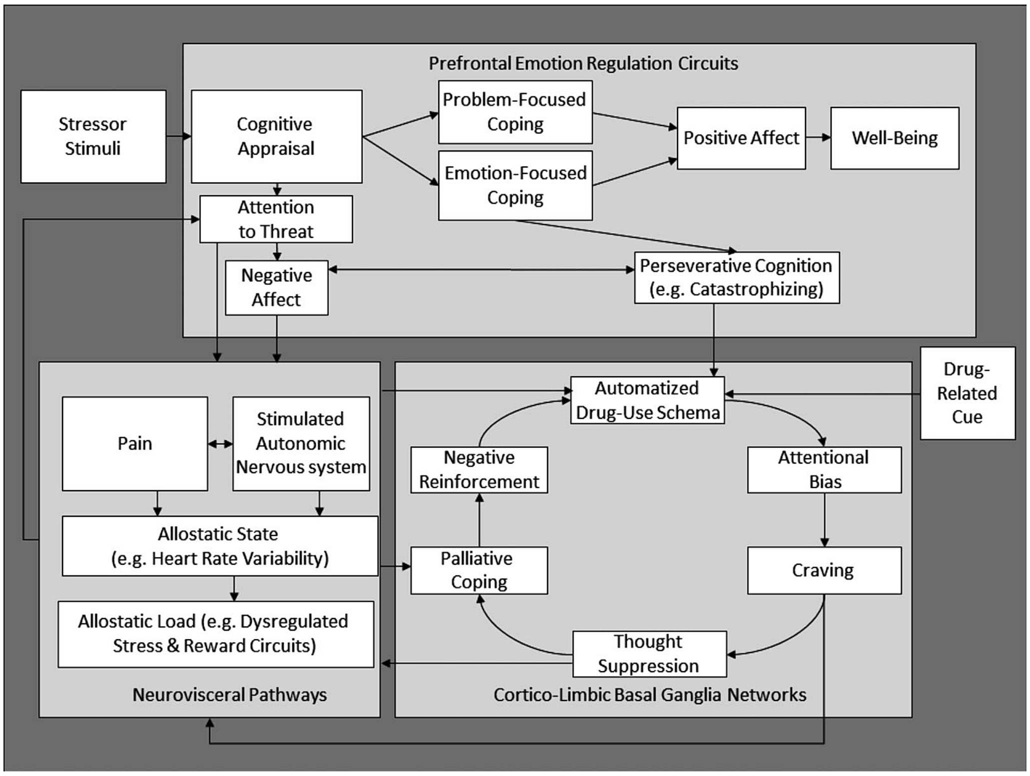

Figure 1: An Integrated, Biopsychosocial Model of Automaticity, Allostasis, and Addiction

field of interpenetrating quantum forces moving through space, you perceive a book—and not merely a book, but a *fascinating* or *confusing* book. Whether you find the book fascinating or confusing may have less to do with the electrons in the ink interacting with those of the paper and more to do with your own history, taste, upbringing, mood, and purpose in reading this text. Hence, the encounter with the environment is interpreted according to its perceived relevance to self and others, a perception that is shaped by the historical, sociocultural, and environmental context in which an individual is embedded. As such, the stress process is hinged on this self-organizing interpretive or evaluative function, known as *cognitive appraisal*.

The development of brain structures that allow for cognitive appraisal was a major evolutionary leap, affording the animals that possessed such structures substantial behavioral flexibility in adapting to environmental demands. Appraisal allows for differences in stress reactivity within and between individuals (Lazarus & Folkman, 1984). Exposed to the same stressor (for example, being fired from a job), one individual may respond with depression and helpless apathy, another with violence and rage, and a third with optimism and constructive action. In each case, the stressor event is the same, but the appraisal of that event results in markedly different emotional, behavioral, and physiological outcomes.

Thus, the stress process begins with an appraisal of the stressor event for its risk value or significance to the self. This initial appraisal is known as a *primary appraisal* (Lazarus & Folkman, 1984). When a given event is appraised as an actual harm, a manifest challenge, or a potential threat, an activation of physiological systems involved in the stress response co-occurs with subjective feelings of distress (Lazarus & Folkman, 1984). Subsequently, a *secondary appraisal* determines whether available resources and coping options are sufficient to meet the demands of the stressor. This appraisal process can be automatic, executed without conscious deliberation (Bargh & Chartrand, 1999). For instance, people typically make predictions about the intent and future behaviors of others in less than 30 seconds (Ambady & Rosenthal, 1992), and reflexive stress appraisals discriminating threatening from benign stimuli (for example, snakes from flowers) can be made within as few as 50 milliseconds (Ohman & Wiens, 2002). Experiments have demonstrated that appraisals of threat can occur completely without consciousness (Ohman, 2005). Thus, such rapid, unconscious appraisals rely on reflexes and memories that have been laid down by past experience (Ellsworth & Scherer, 2002; Scherer, Schorr, & Johnstone, 2001) rather than conscious deliberation. Reflexive, unconscious appraisals for threatening objects and events (for example, angry facial expressions, loud sounds that might herald the approach of a predator, poisonous animals such as snakes and spiders) aid survival and, thus, may have been naturally selected during human evolution (Ohman & Wiens, 2002). In contrast, conscious appraisals are slower and more deliberate, unfolding over minutes (or even longer) as an individual uses reason and logic to interpret the meaning of stressor event.

The neurobiology of stress appraisal is complex. In brief, information about a stressor is rapidly relayed from sensory processing areas of the brain to affective (that is, emotional) processing circuits in the limbic system and parts of the prefrontal cortex (LeDoux, 2002). The amygdala, an almond-shaped structure deep in the brain, in concert with the medial prefrontal and orbitofrontal cortices, serves to process the motivational value of a stimulus. In other words, these brain areas work together to determine whether a given object or event signals a potential benefit or harm to the individual. For example, on the basis of past experiences (for example, previous encounters with strangers), a stimulus (for example, the facial expression of a passerby on the street) is judged to be threatening, innocuous, or even beneficial. As this neural circuitry determines whether a stressor is present, other brain regions such as the anterior cingulate cortex stimulate or dampen the outflows of signals from the brain to the rest of the body to calibrate the stress reaction to the demands of the stressor situation.

If the individual determines (often through a rapid and unconscious process of secondary appraisal) that available resources are insufficient to negotiate the challenge presented by the threatening or harmful stimulus, this appraisal will initiate the biopsychosocial sequelae of the stress reaction. This reaction involves the activation of pathways from the extended amydgala to the hypothalamic–pituitary–adrenal axis, the locus coeruleus, and the autonomic nervous system. This pathway unleashes a neuroendocrine cascade of stress hormones, in which secretion of beta-endorphin and adrenocorticotropin lead to the release of cortisol from the adrenal cortex (Brosschot, Gerin, &

Thayer, 2006). Cortisol promotes the processing of threat-related information and the encoding of fear memories by sensitizing neurotransmission between the amygdala and hippocampus (McEwen, 2007), etching the significance of the stressor deeply within the brain. Furthermore, stress appraisal activates a rapid "fight-or-flight response" (Cannon, 1929) coordinated by the central autonomic network (Thayer & Lane, 2009), a system of neural circuits linking prefrontal cortex, amygdala, brainstem, sympathetic and parasympathetic nervous systems, viscera, and periphery. During the fight-or-flight response, the central autonomic network innervates muscle groups, drives and modulates the pacemaker of the heart, effects gastric contractions, stimulates sweat gland activity, and regulates shifts in body temperature (Janig, 2002). These physiologic reactions prepare the individual to flee or defend against a threatening event.

The fight-or-flight response evolved as a means of adapting to an immediate, life-threatening stressor, yet the context of modern, industrialized society rarely presents humans with such threats. In comparison with the environment of our ancestors, in which the scenario of fleeing from a wild beast was more commonplace, today we more often face stress from our attribution of symbolic meaning to events deemed critical to our psychosocial well-being (Rosmond, 2005). For instance, our bodies may react to a critical e-mail from a supervisor as if we were being attacked by a tiger. Furthermore, although the acute stress response may be adaptive, chronic stress can be harmful. Prolonged activation of stress physiology takes a toll on multiple body systems known as *allostatic load* (McEwen & Wingfield, 2003), which, over time, can result in atrophy of brain tissue, hormonal and metabolic dysregulation, and susceptibility to physical and mental disorders like cardiovascular disease or depression (McEwen, 2003).

2. Reappraisal and Coping Ameliorate Stress

The damaging effects of stress can be moderated by effective coping. Once an event is appraised as stressful, an individual may use problem- and emotion-focused coping efforts to deal with the stressor. Problem-focused coping consists of strategic attempts to manage or resolve the stressful event by gathering information, making decisions, and taking constructive action. When coping efforts lead to a favorable resolution of the stressor event, positive emotions result; however, emotional distress increases when coping attempts are unsuccessful and the stressor is not resolved (Lazarus & Folkman, 1984). If the individual is unable to resolve the stressor, he or she may use emotion-focused coping efforts to manage feelings of distress. One key form of emotion-focused coping is positive reappraisal, the strategy of reinterpreting the stressor event as a source of potential benefit, meaning, or personal growth (Folkman, 1997). This cognitive coping strategy relies on the dynamic intake of new data from the changing environment coupled with information about the effect of one's behavioral reactions to the stressor. During reappraisal, brain activations spread from left to right and posterior to anterior parts of the prefrontal cortex as negative emotions are quelled while alternate interpretations of the stressor are retrieved from memory and evaluated for relevance to the self (Kalisch, 2009).

Positive reappraisal is thought to reduce destructive emotions by the reconstrual of the stressor event as meaningful and growth promoting (Folkman & Moskowitz, 2000). Thus, positive reappraisal is an active coping strategy (Folkman, 1997) rather than a defense mechanism used to repress or deny an unwanted experience. Unlike suppression of negative emotions, which tends to backfire and magnify the stress reaction (Gross & Levenson, 1997), positive reappraisal does not lead to physiological or psychosocial complications (Gross, 2002; Ochsner, Bunge, Gross, & Gabrieli, 2002). Further, positive reappraisal is often a crucial step toward reengaging with the stressor event. For instance, a person stricken with a nonfatal heart attack might positively reappraise the event as an opportunity to change his or her lifestyle and subsequently begin to make changes in diet and exercise behaviors. Alternatively, a person who has recovered from cancer might view his or her survival of the disease as evidence of personal strength and resilience and decide to dedicate his or her life to helping others make similar recoveries. Hence, positive reappraisal is often an adaptive rather than an avoidant strategy. However, in the absence of adaptive emotion-focused coping, stress leads to perseveration.

3. Perseverative Cognition Intensifies Stress

The stress reaction is maintained and prolonged in the absence of an immediate threat through mental representations (that is, thoughts, images, and memories) of a stressor. Unlike a zebra chased by a lion on the African savannah that is able to stop processing threat and de-escalate the stress reaction once it has escaped danger, humans often engage in perseverative cognition, a maladaptive process of fruitlessly maintaining a cognitive representation of a stressor even after it is no longer present (Brosschot et al., 2006). Regions in prefrontal cortex that regulate the amygdala during stress appraisal may become impaired during perseverative cognition, leading to amplified threat perception (Rauch, Shin, & Wright, 2003). Perseverative cognitive styles such as catastrophizing (exaggerating the potential danger of an event) or rumination (repeatedly thinking negative thoughts about an event) result in a downward spiral: Stress appraisals trigger self-destructive emotions like fear, rage, or despair, which result in hypervigilance for future threats, heightened stress sensitivity, and sustained activation of the autonomic nervous system. Protracted activation of this pathway disrupts the homeostasis of body systems through cortisol- and catecholamine- mediated stress responses (Thayer & Brosschot, 2005), which, in the case of an addict in the early process of recovery, may compound the physiological distress of substance craving and withdrawal.

4. Stress Primes Impulsive Consumption of Drugs and Alcohol via Allostasis

Allostatic load from chronic stress and perseverative cognition is thought to dysregulate neurocircuitry within the amygdala such that the normal “set point” of the brain shifts toward increased sensitivity to stress, punishment, or negative emotions and decreased sensitivity to naturally occurring pleasures and rewarding experiences (for example, a delicious meal, a beautiful sunset, or the smile of a loved one) (Koob & Le Moal, 2001). The effects of this sensitization can be observed among people suffering from depressed and anxious mood states, who hyperfocus their attention on objects, people, and events that they construe as disappointing, upsetting, or frightening while neglecting what is beautiful, affirming, or pleasurable (Garland, Fredrickson, et al., 2010; Mathews & MacLeod, 2005). Such biased information processing maintains and intensifies stress, dysphoria, and self-loathing by narrowly focusing the mind on unpleasant experiences and blinding the individual from the good in their lives.

Stress-induced dysregulation of information processing may be particularly pernicious among addicts, who tend to impulsively seek immediate gratification and discount the value of long-term rewards (Boettiger et al., 2007). With repeated use of drugs or alcohol, the brain becomes sensitized in such a way that the substance comes to elicit a potent response in dopamine-releasing neurons of the striatum, a brain structure involved in generating the sense of reward and pleasure. However, chronic use of psychoactive substances reduces the responses of dopamingeric neurons in the striatum to naturally occurring positive objects and events (for example, a beautiful landscape, a smiling baby, a delicious meal). As these neuroadaptations increase over time, the addicted individual becomes dependent on drugs for a sense of reward instead of feeling rewarded by the many pleasures of life that are abundant in the natural environment. This rewiring of reward learning entrenches the addict in a vicious cycle of drug use as a means of regaining a sense of satisfaction and pleasure in life (Koob, 2003) in spite of potential future consequences of use. Yet the addict may not even realize that this neurobiological shift in the reward set point has occurred. Instead, the impulse to drink or get high may arise out of automatic cognitive processes.

5. Automatic Drug-Use Schemas Regulate Addictive Behavior through Cue-Reactivity

Stress and negative emotions coupled with cues associated with past episodes of substance use may trigger *drug-use action schemas*, patterns of habit responses stored in memory that coordinate and compel the use of psychoactive substances (Tiffany, 1990). These schemas encode procedural information like how to load a syringe with heroin, how to tamp down a pack of cigarettes, and how to take a hit off a crack pipe as well as contextual rules like "when feeling anxious, take a shot of whiskey." Cues that are associated with getting high such as the sight of corner where one used to buy drugs, an advertisement for liquor in a magazine, or a familiar "drinking buddy" can automatically trigger the impulse to consume drugs and alcohol long after one has gone through withdrawal and even after extended periods of abstinence. This impulse is often unconscious and executed without willful intent, as evidenced by anecdotal reports of addictive binges in which alcoholics describe having the intent to take a single drink and "the next thing I knew, the bottle was empty," previously abstinent crack addicts describe being "lost" for days in a crack house after relapsing by taking a single hit, and the common experience of sitting in front of the television with a bag of potato chips only to discover 30 minutes later that the whole bag has been eaten. Such consummatory behaviors can operate on "autopilot," in much the same way as other complex thought–action repertoires can be engaged without conscious volition by conditioned contextual cues (Bargh & Chartrand, 1999), like the commonplace occurrence of driving without being fully conscious of the road, the route, or the turns you took to get to your destination.

How do such automatic drug-use action schemas develop from repeated exposures to stress? Frequent use of psychoactive substances in response to stressors initially leads to the formation of behavior–outcome associations (Elsner & Hommel, 2001) as the calming and euphoric effects of intoxicating substances reinforce substance use. At first, such stress-precipitated alcohol and drug use may derive from explicit expectations that such use will provide relief from stress (Cooper, Frone, Russell, & Mudar, 1995; Stewart, Hall, Wilkie, & Birch, 2002). Over time, recurrent substance use under stressful circumstances can lead to automatic habits that may not be affected by adverse consequences. Thus, many addicts continue to drink or use drugs in spite of painful events such as loss of a spouse or job, serving a long prison sentence, or near death in a hospital operating room.

Drug-use action schemas appear to be subserved by neural circuits connecting deep brain structures like the hippocampus, amygdala, striatum, and nucleus accumbens (Everitt & Robbins, 2005). These schemas arise out of a history of repeated substance use in much the same way that other overlearned behavioral repertoires (for example, riding a bike, driving a car) become automatized. Stimulus–response habits are established through repetition (like learning to ride a bike or tie one's shoes). After hundreds of repetitions of consistent responses to a given stimulus, attending and responding to that stimulus become automatic (Shiffrin & Schneider, 1977). During the formation of automatic habits, a neurobiological shift occurs in which behaviors that were originally guided by thoughtful expectation and prediction of potential outcomes become controlled by sensorimotor cortico-basal ganglia networks (Yin & Knowlton, 2006). Addictive consumption of substances appears to derive, in part, from automatized habit. However, among addictions, the alcohol or drug habit has a compulsive or pressured quality. This compulsivity is the result of a neurobiological process known as "incentive sensitization."

Repeated use of psychoactive substances is thought to impart especial motivational significance, or incentive salience, to cues associated with past drug-use episodes by stimulating dopamine-rich areas of the brain (Robinson & Berridge, 2008). Because drug use results in pleasure and an experience of reward mediated by increased dopamine in brain structures such as the ventral tegmental area and nucleus accumbens (Feltenstein & See, 2008), these drug-related cues come to elicit a powerful, conditioned motivational response coupled with a wanting or craving for substances (O'Brien, Childress, Ehrman, & Robbins, 1998; Robinson & Berridge, 2001).

This conditioned response, known as *cue-reactivity*, involves bodily sensations such as tension and jitteriness that co-occur with broad array of physiological reactions in the autonomic nervous system, the cortex, the limbic system, the striatum, and the neuroendocrine system (Bergquist, Fox, & Sinha, 2010; Carter & Tiffany, 1999; Heinz, Beck, Grusser, Grace, & Wrase, 2009; Sinha et al., 2003). Cue-reactivity can motivate the substance-dependent person to consume drugs even after extended periods of abstinence and in spite of countervailing reasons to remain abstinent, particularly when the person is experiencing stress and negative emotions (Garland, Boettiger, & Howard, 2011).

6. Addiction Attentional Bias Is Linked with Craving

Once drug-related cues have acquired incentive salience through conditioning, drug-use action schemas may automatically engage attention to search for and focus on such cues as a means of satisfying the goal of drug use. This unconscious cognitive process manifests as an automatic focus of attention on drug-related cues, known as *addiction attentional bias* (Field & Cox, 2008). Addiction attentional bias may be observed when drug-related cues automatically and preferentially capture attention (such as when a recovering alcoholic arrives at a dinner party and, despite a room full of interesting people and delicious food, finds him- or herself reflexively distracted by a bottle of wine on the table) as well when attention cannot be easily shifted away from drug-related cues (such as when the alcoholic finds him- or herself unable to refocus from the bottle onto a conversation). The fixation of attention on drug-related cues diverts mental resources from carrying out the normal tasks of life and creates an obsessive focus on getting high that may foster substance use and impede recovery. As drug-related cues become the focus of attention, the urge to use drugs increases, which, in turn, amplifies the incentive salience of the cues (Franken, 2003). This cycle can exhaust the resolve to stay sober, particularly under conditions of stress, which intensify attentional bias and amplify drug craving (Field & Powell, 2007).

7. Suppressing Craving Exhausts Willpower and Intensifies the Stress Reaction

Addiction attentional bias and craving mutually enhance one another (Field, Munafo, & Franken, 2009), which can compel drug use even when the addict has no conscious desire or intent to use drugs. Craving itself is a complex phenomenon, involving cognitive, emotional, and neurobiological processes. Theorists debate whether craving is the subjective correlate of classically conditioned drug withdrawal (Ludwig & Wikler, 1974); the cognitive interpretation of cue-related physiological arousal (Melchior & Tabakoff, 1984); the expectation or anticipation of the rewarding effects of drugs (Marlatt & Gordon, 1985); or the cognitive, affective, and physiological reactivity that results from attempting to restrain or suppress drug-use action schemas (Tiffany, 1990). According to Tiffany, addicts in recovery experience craving when they attempt to block or inhibit an automatic impulse to use substances when this impulse is triggered by external (for example, the sight of one's favorite drink) or internal (for example, an emotional state) cues. Thus, craving is more than a mere desire for drugs. In fact, some theorists have suggested that craving can occur in the absence of consciously "liking" drugs and, instead, manifests as a "wanting" or compulsive need for the substance (Robinson & Berridge, 2001). This notion corresponds with the all-too-common clinical anecdote of the recovering addict who, as a result of experiencing many painful losses because of drug use, expresses true disgust for his or her drug of addiction. Despite a sincere desire to remain clean and sober, he or she relapses after struggling to resist an overwhelming compulsion to use triggered by stress and old people, places, and things associated with past drug and alcohol use.

Cascades of physiologic responses, such as increased blood pressure and cortisol levels, co-occur with subjective craving (Fox, Bergquist, Hong, & Sinha, 2007). More centrally, craving appears to involve increased activity in prefrontal cortex and amygdala (Dom, Sabbe, Hulstijn, & van den Brink, 2005; Grant et al., 1996; Heinz, Beck, Grusser, Grace, & Wrase, 2009; Kalivas & Volkow, 2005), whereas the attempt to inhibit craving has been shown to evoke anterior cingulate activity (Brody et al., 2007; Knoch & Fehr, 2007). Activation in these brain regions may correspond to the emotional distress and intrusive thoughts experienced by the addict during a craving episode. Among people in recovery from addiction, craving is often perceived as incongruent with the desire to remain abstinent (Soutullo, McElroy, & Goldsmith, 1998); many addicts believe that if they are craving alcohol or drugs, their motivation to change is not real or is in danger. Therefore, craving often results in feelings of guilt and shame. In response to the disturbing thoughts and feelings that accompany craving, people in recovery from addiction may attempt to suppress the urge to engage in addictive behavior as an expression of their willpower (Bateson, 1971). Although suppression is intended to dampen strong feelings, instead it often aggravates the sympathetic arousal of the fight-or-flight response (Gross & Levenson, 1993; Roberts, Levenson, & Gross, 2008) while reducing the body's capacity to regulate the stress response in the face of addictive cues, manifested in blunted heart rate variability (Ingjaldsson, Laberg, & Thayer, 2003). Indeed, when addicts attempt to avoid paying attention to drug cues, such avoidance is associated with increased sympathetic nervous system activity (Garland, Franken, Sheetz, & Howard, 2012). Ironically, suppression of substance-related thoughts and urges evokes "rebound effects," resulting in attentional fixation on drug cues and increased intrusiveness of substance-related thoughts and feelings (Klein, 2007; Palfai, Monti, Colby, & Rohsenow, 1997). In turn, suppression of thoughts of substance use and eating leads to greater enactment of such behaviors (Erskine & Georgiou, 2010; Erskine, Georgiou, & Kvavilashvili, 2011). Chronic suppression of addictive urges appears to exhaust the neurocognitive resources for self-regulation, resulting in an inability to resist the urge to get high and increased attentional bias towards substance-related cues (Garland, Carter, Ropes, & Howard, 2011). Ultimately, the exhaustion of regulatory resources that occurs during sustained suppression of urges may result in relapse.

8. Palliative Coping through Use of Drugs and Alcohol Is Negatively Reinforcing

Ultimately, substance use may be an attempt to self-medicate the unpleasant feelings and physiological arousal that cause, co-occur with, and follow from stress and craving (Khantzian, 1997). In this way, substance use is a form of palliative coping—that is, coping that does not address the stressor but, rather, is designed to help the individual feel better in spite of the stressor (Olff et al., 2005). Although many addictive drugs are positively reinforcing and produce euphoria through their effects on endorphins and dopamine (Kalivas & Volkow, 2005), the psychopharmacological reduction of negative emotions is thought to be negatively reinforcing (Baker et al., 2004). In other words, the use of substances temporarily relieves unpleasant feelings, thereby increasing the likelihood of substance use under future stressful conditions. In addition, as addiction deepens, withdrawal from drugs and alcohol produces generates negative emotions and physiological distress, motivating the addict to consume more drugs to relieve the discomfort of withdrawal. Ultimately, the negative reinforcement obtained from such palliative coping strengthens the links between the stress reaction and drug-use action schema such that future stressors trigger habitual, addictive behavior automatically in spite of the honest desire to remain clean.

In sum, from this neurocognitive perspective, a person becomes addicted through basic human learning processes gone awry. In the case of an addiction to a psychoactive substance, cognitive processes which normally help us learn how to obtain satisfaction from naturally-occurring sources of pleasure become hijacked due to the neuropharmacologically rewarding properties of the drug itself (Hyman, 2007). The once-intentional behavior to seek and consume drugs becomes rapidly ingrained as an automatic, compulsive habit, one that becomes increasingly difficult to control. As the individual addict struggles to regain control over his or her behavior, he or she becomes hypervigilant for cues—such as the sight of a bar, an old hangout spot, or a familiar "drinking buddy"—which can reflexively trigger uncomfortable physical sensations and a strong desire to consume substances, even after extended periods of abstinence. When such cue-reactivity is amplified by life stress, the urge to use may become overwhelming, and misguided attempts to suppress such urges only make them worse. Eventually, the addict relapses, which strengthens the addictive habit through processes of conditioning. This pattern drives relapse into a self-destructive, downward spiral.

WHY MORE?

Given that negative emotion, automaticity, cue-reactivity, attentional biases, and suppression of craving are integral components of the risk chain of stress-induced addictive behavior, therapies that address these factors can strengthen the recovery process. MORE was designed to target each of these components with powerful, evidence-based techniques and principles drawn from mindfulness training, cognitive–behavior therapy (CBT), and positive psychology.

Mindfulness meditation, which has been translated and transformed over the past several decades from an ancient spiritual tradition to a modern therapeutic approach, has been shown to effectively reduce psychosocial distress and improve health outcomes across many clinical issues (Chiesa & Serretti, 2010; Greeson, 2009; D. S. Ludwig & Kabat-Zinn, 2008). Controlled research trials (Astin, 1997; Bowen et al., 2009; Davidson et al., 2003; Garland, Gaylord, Boettiger, & Howard, 2010; Gaylord et al., in press; Kabat-Zinn et al., 1998; Kuyken et al., 2008; Ma & Teasdale, 2004; Teasdale et al., 2000) have identified significant, beneficial effects of mindfulness practices on a variety of stress-related psychological and physiological health outcomes, including stress, depression, anxiety, chronic pain, immune response, endocrine function, and addiction. Thus, a growing body of scientific studies suggests that mindfulness training exerts therapeutic effects on mind and body that may ultimately foster recovery from addiction.

CBT is an evidence-based practice. Over 300 well-controlled research studies have shown that CBT is an effective means of treating a wide range of conditions, including addiction, and a recent meta-analysis suggested that CBT is significantly more effective than other psychotherapies at treating emotional problems (Tolin, 2010). MORE incorporates the empirically supported CBT techniques of cognitive restructuring (that is, the process of identifying and modifying maladaptive thoughts via methods such as logical disputation) and imaginal rehearsal (that is, the use of imagery to rehearse effective responses to stress, craving, and addiction triggers).

Positive psychology is the scientific study of characteristics, virtues, and strengths that allow individuals to thrive (Seligman, Steen, Park, & Peterson, 2005). Studies suggest that psychotherapeutic techniques designed to promote positive emotions, values, and meaningful actions have important clinical effects (Seligman, Rashid, & Parks, 2006). MORE incorporates key therapeutic principles from positive psychology, such as intentionally savoring pleasant events (Bryant, Chadwick, & Kluwe, 2011) and cultivating compassion towards self and others (Neff, 2003) to increase well-being and facilitate recovery from addiction.

Drawing on techniques, skills, and principles derived from mindfulness training, CBT, and positive psychology, MORE is a targeted intervention that aims to ameliorate addiction through a number of specific therapeutic mechanisms, as outlined in Figure 2. Here I offer theoretical rationale and research evidence in support of these hypothetical mechanisms of action.

1. MORE Aims to Reduce Stress Reactivity by Increasing the Accuracy of Cognitive Appraisals

During mindfulness training, clients are taught to become aware of their thoughts, emotions, bodily sensations, and perceptions without judging them or reacting to them. As such, mindfulness has been conceptualized as awareness without emotional distor-

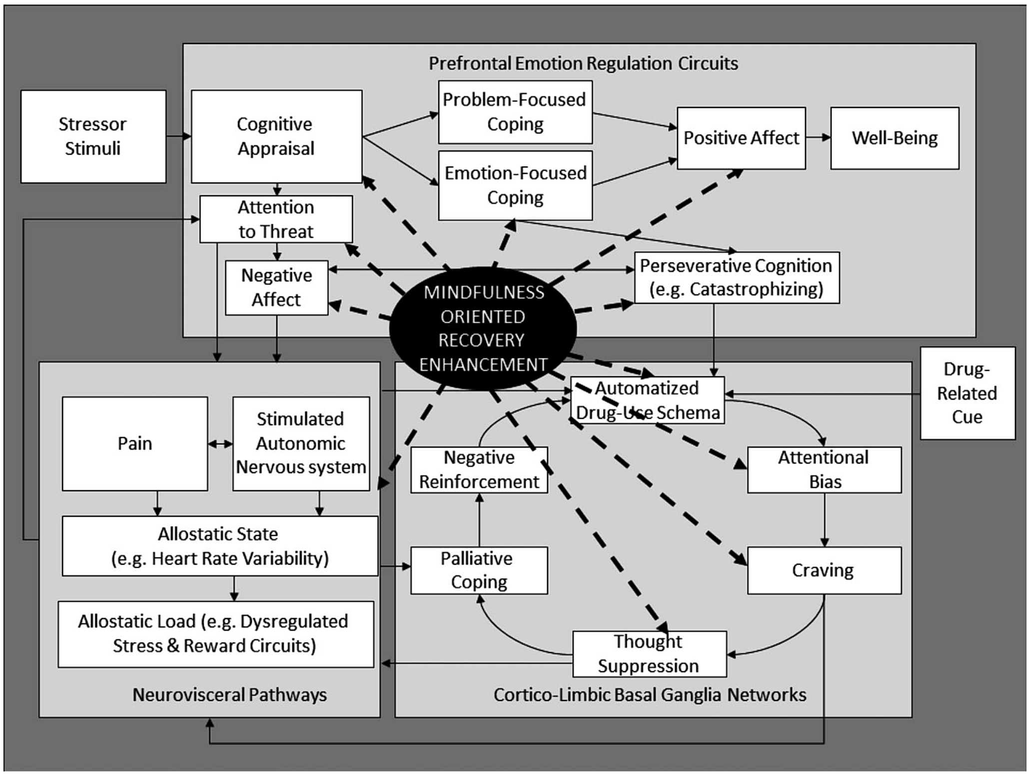

Figure 2: Hypothesized Therapeutic Action of Mindfulness-Oriented Recovery Enhancement

tions and reactivity (Bishop et al., 2004). Emotional distortions and reactions tend to arise from perseverative cognitive processes (for example, catastrophizing) and often result in avoidant behavior and increased stress. When these distortions and reactions become deeply entrenched as a habitual pattern of negative thinking, perception becomes biased such that the individual tends to exaggerate threats and underestimate his or her ability to manage them successfully (Mathews & MacLeod, 2005). As a person comes to expect negative outcomes and hyperfocuses on unpleasant events, stress appraisals are amplified. In other words, he or she comes to view the world as a hostile and dangerous place and comes to view his or herself as being helpless or unable to cope with adversity. Mindfulness may help the individual to view his or her present circumstances more clearly and accurately and to more accurately assess his or her ability to cope with present challenges. Thus, mindfulness may lessen the impact of emotional bias on information processing and, thereby, decrease catastrophic appraisals of life events. In that regard, mindfulness training has been shown reduce information processing bias among people with depression diagnoses (De Raedt et al., 2011; Williams, Teasdale, Segal, & Soulsby, 2000). Moreover, mindfulness practitioners exhibit decreased activity in the amygdala, a brain structure intimately involved in emotional appraisals, during exposure to negative emotional cues (Taylor et al., 2011) and negative self-beliefs (Goldin & Gross, 2010). Amazingly, Hölzel et al. (2010) found that the amygdalae of participants in a mindfulness training course actually decreased in volume (that is, shrank) after eight weeks of mindfulness practice and that the more stress reduction participants experienced, the more their amygdalae decreased in size! These neurobiological changes suggest that mindfulness decreases emotional reactivity, which may obviate the need to self-medicate stress with alcohol or drugs.

2. MORE Aims to Improve Emotion Regulation as a Means of Coping with Stress

Many studies have demonstrated that mindfulness training can improve the ability to regulate negative emotions (for a review, see Hölzel et al., 2011). In a similar manner, negative emotions can be powerfully addressed with cognitive restructuring, a CBT technique which challenges maladaptive appraisals of distressing life events and replaces them with alternative, more adaptive ways of thinking (Beck, Rush, Shaw, & Emery, 1979; Clark & Beck, 2010). MORE uses mindfulness meditation practices combined with cognitive restructuring to facilitate emotion regulation in two primary ways. One, MORE uses mindfulness practices (for example, mindful breathing) to disrupt perseverative cognition, helping the individual to let go of ruminations and stop catastrophizing (Garland, 2007). Two, MORE provides instruction in "mindful reappraisal" by using mindfulness practice as a means of promoting positive reappraisal (Garland, Gaylord, & Park, 2009). Indeed, mindfulness practice and positive reappraisal appear to mutually facilitate one another with the dynamics of an upward spiral (see Figure 3), such that the positive mental states generated by mindfulness practice tune attention toward what is beautiful, rewarding, or meaningful in life and thereby strengthen positive interpretations of the current situation (Garland, Fredrickson, et al., 2010). This theory has been supported by recent studies (for example, Troy, Shallcross, Davis, & Mauss, 2012), and my own research indicates that as people become more mindful, they tend to positively reappraise the stressors in their lives as opportunities for personal growth, which in turn explains how much stress reduction they achieve as a result of their increased mindfulness (Garland, Gaylord, & Fredrickson, 2011). During the practice of mindful reappraisal, one disengages from his or her initial negative appraisal into an open-minded metacognitive awareness in which thoughts and feelings are viewed as ephemeral mental events rather than accurate reflections of reality. In the process, attention broadens to encompass a larger set of information from which one may generate new appraisals of the challenging life circumstance. By accessing this enlarged set of data pertaining to the situation, an individual can more easily reappraise his or her circumstances as meaningful or growth promoting. For instance, a recovering alcoholic might reappraise an affront by an old drinking buddy as further confirmation of his or her decision to build new, sober relationships. Speculatively, this process of mindful reappraisal may involve activation of the anterior cingulate, ventro-

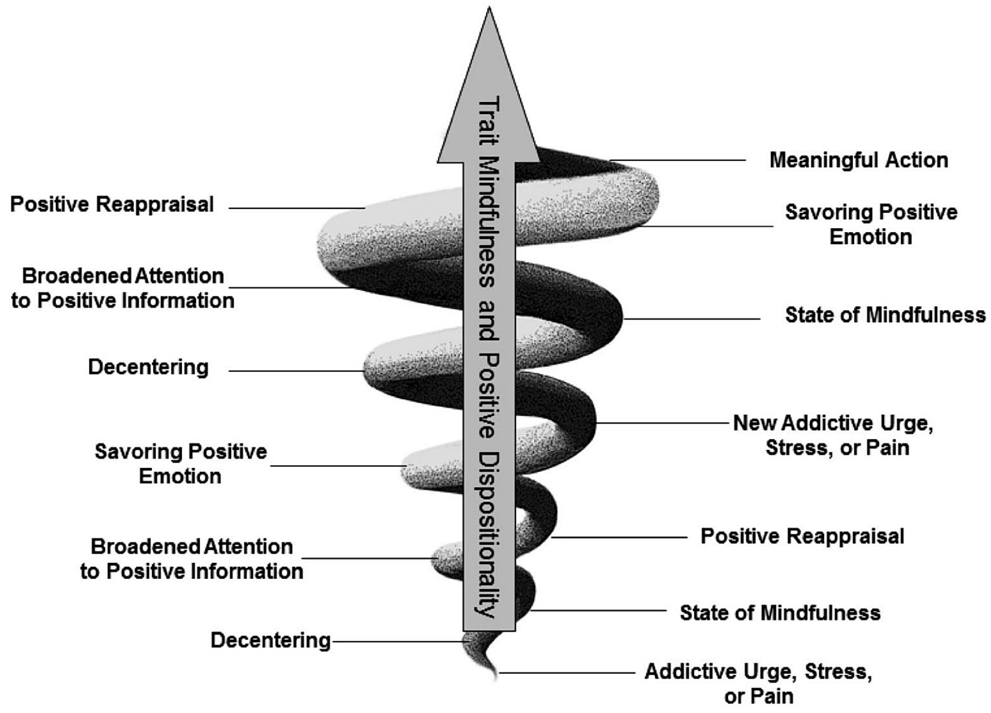

Figure 3: Upward Spiral of Mindfulness, Meaning, and Positive Emotion

medial, and dorsolateral prefrontal cortices, brain regions that have been shown to be activated both during mindfulness meditation and reappraisal (Chiesa & Serretti, 2010; Hölzel et al., 2007; Kalisch, 2009).

3. MORE Aims to Undo the Physiological Stress Reaction

Mindfulness training through MORE may reduce stress by decreasing the sympathetic "fight-or-flight" response and inducing a compensatory parasympathetic relaxation response. Studies have identified effects of mindfulness meditation on physiological indicators of the stress reaction, such as decreased blood pressure (de la Fuente, Franco, & Salvator, 2010), heart rate (Zeidan, Johnson, Gordon, & Goolishan, 2010), muscle tension (Benson, Beary, & Carol, 1974), skin conductance responses (Tang et al., 2009), and cortisol levels (Carlson, Speca, Faris, & Patel, 2007). In addition, mindfulness meditation increases heart rate variability, a marker of increased parasympathetic activation, to an even greater extent than does relaxation therapy (Ditto, Eclache, & Goldman, 2006; Tang et al., 2009). The effects of MORE on autonomic stress reactions may result in an improved ability to manage cue-reactivity. Indeed, my colleagues and I found that MORE influences parasympathetic nervous system responses by increasing heart rate variability recovery from stress and alcohol cues (Garland, Gaylord, et al., 2010). This study is described in greater detail in chapter 14. Another study showed that relative to their less mindful counterparts, alcohol-dependent individuals with higher levels of trait mindfulness exhibited greater cardiovascular recovery from stress and alcohol cue-reactivity (Garland, 2011). Thus, as people recovering from addiction strengthen their mindfulness as a result of mindfulness training, they appear to be better able to engage prefrontal cortical regulation of the stress reaction via parasympathetic nervous system activation of the "vagal brake," resulting in increased heart rate variability and heart rate deceleration in the face of stress or addictive cues (Porges, 1995; Thayer & Lane, 2009). In so doing, mindful individuals may have greater capacity for engaging and disengaging self-control resources in response to the presence and absence of stress and drug cues. Such autonomic flexibility (Friedman, 2007) developed through mindfulness training may help people in recovery from addiction adapt to situational demands without falling into stress-precipitated relapse.

4. MORE Aims to Increase the Sense of Reward from Natural Pleasures through Savoring

By instructing participants to mindfully focus attention on pleasurable objects and experiences (for example, a beautiful nature scene or the satisfying taste of a meal), MORE may increase the sense of reward they receive from pleasant events. Such mindful savoring increases positive emotion (Quoidback, Berry, Hansenne, & Mikolajczak, 2010) and may counter the allostatic effects of addiction on reward neurocircuitry in the brain (Koob & Le Moal, 2001). Given that attending to present-moment experience predicts happiness (Killingsworth & Gilbert, 2010), learning to mindfully attend to and savor positive events may offset mood disorders and anxiety that often trigger addictive responses. A number of studies suggest that mindfulness training may enhance reward experience and positive emotion in both healthy and clinical populations (Garland, Fredrickson, et al., 2010). For instance, among healthy individuals, mindfulness training improved positive emotional information processing, which has been linked with increased positive affect (Roberts-Wolf et al., 2012). Moreover, Geschwind et al. (2011) found that mindfulness training increased reward experience from pleasant events throughout daily life among people recovering from major depressive disorder. Capitalizing on these effects, MORE retrains the addicted individual to experience by the subtle beauty of happiness and joy by appreciating the natural environment, the pleasures contained within, and the close emotional bonds of loved ones and friends.

5. MORE Aims to Disrupt Drug-Use Action Schemas

MORE may increase attention to triggers and the presence of craving, enabling a skillful deployment of coping strategies. If, as Rohsenow et al. (1994) observed, inattention to substance-related cues is associated with increased substance use, then automatic alcohol and drug use may be decreased by using mindfulness to enhance attention to addictive triggers. Furthermore, MORE may increase awareness of the activation of drug-use action schemas when triggered by substance-related cues or negative emotion, thereby allowing for the disruption of automatic addictive habits with a controlled coping response. Abstaining from the use of drugs and alcohol requires the deployment of conscious cognitive control mechanisms in stressful situations (Wiers et al., 2006). In light of evidence that mindfulness meditation increases access to unconscious processing (Strick, van Noorden, Ritskes, de Ruiter, & Dijksterhuis, 2012) and reduces overreliance on cognitive and behavioral habit responses (Greenberg, Reiner, & Meiran, 2012; Wenk-Sormaz, 2005), MORE may increase awareness of automatic addictive tendencies and strengthen conscious control over them.

6. MORE Aims to Modify Addiction Attentional Bias

Given that drug-use action schemas are triggered by cues associated with past episodes of substance use, the activation of these automatic addictive habits may be interrupted by shifting attention from substance-related triggers to innocuous objects and events. Mindfulness training involves practices that train sustained attention and vigilant monitoring, in which the practitioner repeatedly places his or her attention onto an object (for example, the sensation of breathing, the sensation of walking) while alternately accepting and letting go of distracting thoughts and emotions (Lutz et al., 2007). As such, research suggests that mindfulness is linked with improved regulation of attention (Chiesa, Calati, & Serretti, 2011). Specifically, mindfulness training is associated with strengthening of functional connectivity of the dorsal attentional network in the brain (Froeliger et al., 2012) and can increase attentional reorienting (that is, the ability to engage, disengage, and move attention efficiently from one object to another) (Jha, Krompinger, & Baime, 2007). Moreover, long-term mindfulness training strengthens alerting (Jha et al., 2007; MacLean et al., 2011) (that is, vigilant preparedness to selectively attend to incoming stimuli). Specific to addiction, recovering addicts who are higher in trait mindfulness are better able to disengage their attention from addictive cues (Garland, Boettiger, Gaylord, West Channon, & Howard, 2011), which predicts the extent to which they can physiologically recover from exposure to such cues (Garland, 2011). Moreover, my colleagues and I showed that 10 weeks of MORE exerted significant effects on alcohol attentional bias (Garland, Gaylord, et al., 2010). This study described in greater detail in chapter 14. MORE offers training in disengaging attention from people, places, and things associated with past substance use (including internal body sensations stemming from stress and negative emotions) and refocusing on neutral or health-promoting stimuli, such as the sensation of one's own breath or a beautiful sunset. Over time, this practice may weaken linkages between substance-related cues and drug-use action schemas.

7. MORE Aims to Regulate Urges by Decreasing Neural and Emotional Reactivity and Promoting Awareness of Craving

MORE may positively influence the urge to use addictive substances in several ways. First, insofar as mindfulness involves cultivating nonreactivity toward emotionally significant objects and events, MORE may reduce craving responses in the brain. Indeed, mindfulness practice has been shown to decrease the reactivity of craving-related brain areas (for example, the anterior cingulate cortex and the striatum) to drug cues (Westbrook et al., 2011). Second, MORE may unhinge negative emotion from craving such that an addict experiencing sadness, fear, or anger could allow these emotions to arise and pass without triggering an addictive impulse. Although negative emotion is a common trigger of craving and subsequent relapse (Marlatt, 1996), mindfulness training has been shown to weaken the association between negative emotion and craving (Witkiewitz & Bowen, 2011). Third, MORE may increase awareness of craving. Tiffany (1990) proposed that conscious craving occurs when an activated drug-use action schema is blocked from obtaining the goal of drug consumption. As such, people in acute withdrawal, people unable to obtain drugs (for example, due to lack of money or access to a dealer), or people attempting to remain sober in the face of triggers may experience an upwelling of craving. In contrast, according to this theory, addicts who are able to seek and use drugs in an unconstrained fashion would not experience craving. In a similar manner, people in long-term residential treatment who are isolated from drug-related cues are unlikely to be aware of craving. Without awareness of craving, the addict may unwittingly remain in high-risk situations and, thus, be especially vulnerable to relapse (Rohsenow et al., 1994). MORE may increase conscious access to the urge to use substances by increasing body awareness (Hölzel et al., 2011; Sze, Gyurak, Yuan, & Levenson, 2010) and, thereby, allow the person in recovery to cope with and regulate craving.

8. MORE Aims to Facilitate Extinction of Conditioned Addictive Reactions without Thought Suppression

To the extent that thought suppression has been found to heighten autonomic stress reactivity and paradoxically increase the occurrence of the very thoughts and moods it is directed against (Wegner & Zanakos, 1994; Wenzlaff & Wegner, 2000), mindful exposure to thoughts, feelings, and urges related to substance use may prevent this postsuppression rebound effect. Indeed, changes in thought suppression have been shown to mediate the effects of mindfulness training on alcohol use and drinking consequences (Bowen, Witkiewitz, Dillworth, & Marlatt, 2007). MORE provides an effective alternative to suppressing unpleasant emotions, cravings, and thoughts about using substances through acceptance and encouraging a nonjudgmental "turning toward" these experiences. This practice may be conceptualized as a form of mindful exposure (Hölzel et al., 2011), which can facilitate the experiencing of unpleasant events in the mind and body without avoidance or reactivity, and help the individual to become desensitized to experiences that were previously felt to be distressing. As is discussed in chapter 14, MORE has been shown to lead to significant reductions in thought suppression, which were associated with decreased addiction attentional bias and improved physiological recovery from stress and addictive cues (Garland, Gaylord, et al., 2010). Thus, mindful exposure through MORE may extinguish conditioned addictive reactions lead to an unlearning of former associations between triggers, craving, habitual emotional reactions, and addictive behaviors.

Chapter 14 details how current research sheds light on the therapeutic mechanisms of MORE. Now, in the following 10 chapters, each session of MORE is presented in treatment manual format for ease of implementation in the field.