just being able to cope with negative stressors, and that the sheer increase in quantity of positive emotional experiences brought about by loving-kindness practice enhances a number of personal resources, such as an increase in well-being, perceived closeness to others, and prosocial behavior (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Kok et al., 2013; Leiberg, Klimecki, & Singer, 2011; Weng et al., 2013). Thus, while not conclusive, there is evidence to suggest that enhancing the ability to self-generate positive emotion is both possible, and beneficial to oneself and others.

**CONCLUSION**

How we go about managing our emotions is one of the perennial discussions in human inquiry, and it has often boiled down to an image of a struggle between controlled, endogenous cognition and unwanted, exogenous emotion. As such, it is not surprising that research and theorizing have emphasized how emotion affects cognition, and vice versa. However, what we hope to have conveyed is that this opposition is not written in stone, but that the two can be used together in a controlled fashion to enhance one's well-being. As research on compassion shows, emotion generation can be used to adapt to situations in which the sheer suppression of emotional processes is counterproductive, potentially enabling both enhanced resilience in the face of external stressors, as well as the ability to deal with such stressors in a prosocial way. Furthermore, it is increasingly becoming apparent that, despite whatever the evolutionary origins and functions of emotions might be, people are actively seeking out emotional states that promote goal-congruent behavior—that is, using emotions in an instrumental fashion (Ford & Tamir, 2012; Kim, Ford, Mauss, & Tamir, 2015; Tamir, Mitchell, & Gross, 2008). As such, the capacity to use cognitive processes to flexibly adapt one's emotional milieu through the endogenous generation of emotion is likely to be an important, but frequently overlooked, component of our self-regulatory toolbox.

**7.8 AFTERWORD**

*How Are Emotions Regulated by Context and Cognition?*

**Alexander J. Shackman and Regina C. Lapate**

In the first edition of *The Nature of Emotion*, Ekman and Davidson asked, *Can we control our emotions?* Two decades later, it is clear that the answer is a resounding *Yes* (Buhle et al., 2014; Etkin, Buchel, & Gross, 2015; Gross, 2015a, 2015b; Sheppes, Suri, & Gross, 2015). With this in mind, the volume editors posed a much broader question for the second edition: *How are emotions regulated by context and cognition?*

**COGNITION AND THE GENERATION OF EMOTION**

Several contributors emphasize the important role that cognition plays in the generation of emotion (Lazarus, 1991). Engen and Singer and Clore and Reinhard remind us that moods and emotions are often triggered by our thoughts; that humans are prone to worrying (or fantasizing) about the future and ruminating about (or nostalgically reflecting on) the past (Killingsworth & Gilbert, 2010). Engen and Singer argue that humans are endowed with the capacity to deliberately generate particular emotions (e.g., Damasio et al., 2000; Velten, 1968). They suggest that this kind of “endogenous” emotion generation reflects the cooperation of numerous large-scale brain circuits (cf. Barrett and Wager’s responses to Question 5), including the frontoparietal control, ventral attention, and salience, limbic, and default mode networks.

Blanchard and Pearson and Marin and Milad note that learning and memory play a crucial role in determining which cues and contexts elicit emotion. Blanchard and Pearson note that emotional learning does not require direct experience; it can be vicariously acquired through observation or, in humans at least, through exposure to other media (Olsson & Phelps, 2007; Raio & Phelps, 2015; Schindler, Vriends, Margraf, & Stieglitz, 2016). Blanchard and Pearson write that people are capable of showing rapid acquisition of fear or anxiety responses to stimuli that they have never even encountered, after hearing, reading, or watching actors portray tales of the horrors associated with such stimuli. One of the present authors [Caroline Blanchard] slept for nearly two years with a scarf tied around her neck after reading Bram Stoker’s *Dracula* at an unwisely precocious age.

Marin and Milad review recent advances in our understanding of the neural circuitry underlying normal and pathological fear learning in humans, highlighting the importance of the amygdala, hippocampus, dorsal or mid-cingulate cortex, and ventromedial prefrontal cortex for fear learning and extinction.
A number of contributors argue that cognitive appraisals (Ekman & Cordaro, 2011; Lazarus, 1991), “emotional evaluations” (LeDoux, 1994), or “pattern detectors” (Levenson, 2011) are key determinants of whether a particular emotion is generated, and, if so, how strongly it is expressed and experienced. Blanchard and Pearson suggest that anger and other aggressive states require an appraisal of the goal that is being thwarted or the object that is being disputed (e.g., What is the nature of the attachment or claim? how important or desirable is the goal or object? for related views, see Averill, 1983; Ekman & Cordaro, 2011; Ekman & Friesen, 1975; Frijda, 1994a, 1994c; Lazarus, 1994a, 1994b). They argue that cognitive appraisals also determine the probability and intensity of overt behavioral aggression (see Lemay’s response to Question 9). In social contexts, for example, this involves sizing up both the opponent (e.g., bigger or dominant opponents inhibit aggressive behaviors) and the longer-term prospects of punishment or retaliation. Atlas makes a related point, noting that placebo effects on pain intensity and pain-related affect hinge on patients’ appraisals of the treatment context, including the nature of the patient–provider relationship. Clore and Reinhard argue that the intensity, duration, or recurrence of feelings reflects the perceived importance of challenges, which scales with the number of undesirable or desirable implications that spring to mind (echoing Rolls’s response to Question 8). They go on to suggest that emotional intensity also depends on the degree to which an elicitor dominates the focus of attention. As the spotlight of attention narrows to include only the eliciting stimulus, intensity increases.

Blanchard and Pearson tell us that cognitive appraisals can determine which emotion is elicited (for related perspectives, see Adolphs’s and Lang and Bradley’s responses to Question 1, and Rolls, 2005). Here, they draw a distinction between states of “fear” and “anxiety” (Fox & Shackman, in press; Lazarus, 1991, 1994a, 1994b; LeDoux & Pine, 2016; Pine & LeDoux, 2017; Shackman & Fox, 2016). They propose that “fear” is generated when danger is deemed certain and inescapable, as with a rapidly approaching predator. “Anxiety,” in contrast, is elicited by less certain or acute threats, including predator odors, conspecific alarm calls, or novelty. Appraisals can be quick and automatic (e.g., Is escape possible?) or slow, deliberate, and conscious (Ekman, 1977, 1994; Lazarus, 1991). Maoz and Bar-Haim seem to focus on the latter, telling us: “If a colleague is late for a meeting, one may become angry if he or she recalls prior incidents in which this colleague was late, and thus interpret this behavior as disrespectful or careless. Alternatively, if . . . this particular colleague is always on time, one may feel surprised or concerned” (for related perspectives, see Averill, 1983; Clore, 1994; Frijda, 1994b).

**COGNITION AND THE REGULATION OF EMOTION**

Several contributors underscore the importance of deliberate attempts to regulate emotion. As Lieberman notes,

> Whether we are trying to avoid showing how nervous we are at the beginning of a presentation, taking our mind away from the current moment to reduce the distress of a broken arm, or trying to reframe things in a new light to recover from a broken heart—we often try to manage our emotions to feel differently or at least look like we are feeling differently. (See also Lemay’s response to Question 9.)

Van Reekum and Johnstone describe evidence that dysfunctions in emotion regulation can contribute to the development and maintenance of mood disorders. Both sets of authors describe several strategies for regulating emotion, including suppression of the emotional response, distraction or the redirection of attention, and different forms of cognitive reappraisal (e.g., reframing the valence or importance of the elicitor; “This will be good for me”; “Who cares, anyway?” or “This is even better than I expected”). Lieberman and van Reekum and Johnstone highlight evidence that cognitive reappraisal strategies are effective at reducing both the outward expression and the inner experience of negative affect. Both sets of authors note that this is associated with increased activation in prefrontal control regions and reduced activation in the amygdala (a point also highlighted in Okon-Singer and colleagues’ response to Question 8). Engen and Singer tell us that the endogenous generation of emotion is an important, but frequently overlooked, component of our self-regulatory toolbox and that such techniques may be particularly useful for individuals who, by virtue of their occupation, regularly witness emotional suffering (e.g., healthcare professionals, clergy, social workers, first responders). They suggest that the capacity to endogenously generate positive emotions is plastic and can be systematically cultivated using a variety of traditional contemplative...
techniques (e.g., loving-kindness and compassion meditation).

Lieberman as well as van Reekum and Johnstone draw a distinction between deliberate and more automatic or implicit forms of emotion regulation, such as fear extinction (Etkin et al., 2015) or gaze aversion (see Okon-Singer and colleagues’ response to Question 8). Lieberman reviews an emerging body of evidence that simply putting feelings into words, which he terms “affect labeling,” can dampen the experience and expression of negative affect—as indexed by changes in self report, peripheral-physiological and neural measures—in ways that resemble the cascade of effects observed following engagement of more direct regulatory strategies, like cognitive reappraisal.

Distinguishing implicit emotion regulation from the natural decay of transiently elicited emotions can be challenging (Goldsmith & Davidson, 2004; Gross & Barrett, 2011). Van Reekum and Johnstone question, “When does the reactivity stop and the regulation start?” noting that it often remains unclear whether emotions are actively managed in contexts where regulation is not explicitly manipulated (e.g., as with “display rules” for emotion; Ekman, 1972; Safdar et al., 2009). Ekman and Davidson made a related point in the first edition of this volume: “There might never be a point where emotion is completely uncontrolled. Rather, it might be more appropriate to consider the degree of regulation that is in effect, not whether such regulation is present” (Ekman & Davidson, 1994b, p. 281). With this in mind, van Reekum and Johnstone describe recent work focused on emotional “recovery” (i.e., return to baseline) following the offset of an elicitor. While it is not a clear-cut example of either reactivity or regulation, this kind of emotional “spill-over” may be particularly important for understanding temperament, personality, and the development of emotional disorders (Shackman et al., 2017).

**FUTURE CHALLENGES**

Several authors describe the challenges of understanding how context and cognition influence emotion. Van Reekum and Johnstone emphasize the need to develop a deeper understanding of the elementary cognitive processes that mediate deliberate attempts to regulate emotion (Urry, 2010). They highlight the importance of well-matched control conditions and the value of studying the temporal dynamics or “chronometry” of emotion generation and regulation (Davidson, 1998; Heller, Johnstone, Light, et al., 2013; Heller, Johnstone, Peterson, et al., 2013; Heller et al., 2009; Tracy, et al., 2014). Marin and Milad underscore the need to clarify the role of demographic variables (e.g., age, sex, ethnicity, education, and IQ) that are known to influence risk for emotional disorders. Atlas suggests that a number of approaches developed in the pain and placebo literatures could be profitably applied to understanding the influence of specific contexts and cognitive processes (e.g., expectancies) on emotion (Ashar, Chang, & Wager, 2017; Geuter, Koban, & Wager, 2017; Koban, Jepma, Geuter, & Wager, 2017; Schafer, Geuter, & Wager, 2018).

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SECOND EDITION

THE NATURE OF EMOTION

Fundamental Questions

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INTRODUCTION

1. For example, the International Society of Research on Emotion (ISRE); Society for Affective Science (SAS); and Social & Affective Neuroscience Society (SANS).

2. Cognition and Emotion; Cognitive, Affective, & Behavioral Neuroscience; Emotion; Emotion Review; IEEE Transactions on Affective Computing; Motivation and Emotion; and Social Cognitive and Affective Neuroscience.

CHAPTER 1.1

1. All the transcriptions of James's words are drawn from Volume II of The Principles of Psychology, in the Dover Edition, 1950. Italicized passages are as published by James.

CHAPTER 1.5


2. Personal communication, November 1, 2014.

CHAPTER 1.9

1. Ekman and Davidson made a similar point in the first edition of this volume: "Is there a sine qua non for emotion? The answer at this time must be No. The investigator must use multiple methods to study emotion, including, wherever possible, measures of behavior, subjective experience, and physiology" (p. 414).

CHAPTER 3.3

1. Anatomically, the amygdala is poised to assemble a broad spectrum of emotional reactions via projections to the brain regions that proximally mediate many of the behavioral (e.g., passive and active avoidance), peripheral physiological (e.g., cardiovascular and neuroendocrine activity), and cognitive (e.g., vigilance) features of momentary negative affect (Shackman et al., 2016; Fox & Shackman, in press).

2. Although these findings highlight the contributions of the amygdala to trait-like differences in threat reactivity, it is by no means the only relevant region. Mechanistic and imaging work highlights the important contributions of a distributed circuit encompassing the anterior hippocampus, anterior insula/orbitofrontal cortex, and periaqueductal gray (PAG) (Fox & Kalin, 2014; Fox, Oler, Shackman, et al., 2015; Fox, Oler, Tromp, Fudge, & Kalin, 2015; Fox et al., 2010; Fox, Shelton, Oakes, Davidson, & Kalin, 2008; Kalin, Shelton, & Davidson, 2007; Oler et al., 2010; Shackman et al., 2013). Like the amygdala, activity in each of these regions predicts trait-like individual differences in stressor reactivity.

3. Relations between temperament and resting-state brain activity are not limited to the amygdala—dispositionally negative monkeys, children, and adults also show greater resting-state activity in the electroencephalogram (EEG) over the right compared to the left prefrontal cortex (PFC) (Oler et al., 2016; Wacker, Chavanon, & Stemmler, 2010). Like the negative phenotype, individual differences in resting prefrontal EEG asymmetry emerge early in life and are relatively stable over time, reliable, heritable, and predictive of the intensity of emotional reactions to aversive stimuli (Fox, Henderson, Marshall, Nichols, & Ghera, 2005; Smit, Posthuma, Boomsma, & De Geus, 2007; Towers & Allen, 2009; Wheeler, Davidson, & Tomarken, 1993). Like the dispositional-negativity phenotype, resting prefrontal EEG asymmetry: (a) prospectively predicts the first onset of mood disorders (Nusslock et al., 2011), (b) is exaggerated in patients with anxiety and mood disorders (Thibodeau, Jorgensen, & Kim, 2006; Nusslock et al., 2018), and is normalized by anxiolytic drugs (Oler et al., 2016). Furthermore, direct neurofeedback manipulations of prefrontal EEG attenuate negative affect elicited by subsequent exposure to aversive stimuli (Allen, Harmon-Jones, & Cavender, 2001). With the pharmacological evidence, this suggests that the neural mechanisms responsible for generating this electrophysiological marker causally
contribute to trait-like individual differences in threat reactivity. Recent efforts to pinpoint the source of the scalp-recorded EEG asymmetry have highlighted the importance of the dorsolateral prefrontal cortex (dLPFC; Shackman, McMenamin, Maxwell, Greischar, & Davidson, 2009), consistent with this region’s well-established role in regulating momentary affect (Buhle et al., 2014).

4. Individual differences in BST activity may reflect altered communication with the orbitofrontal cortex (OFC). Large-scale imaging studies in monkeys (n = 592) demonstrate that threat-related metabolic activity in the OFC is heritable and predictive of trait-like differences in dispositional negativity (Fox, Oler, Shackman, et al., 2015). Moreover, selective OFC lesions are associated with decreased passive avoidance of uncertain threat and reduced BST activity in monkeys (Fox et al., 2010; Kalin et al., 2007), paralleling the consequences of naturally occurring OFC insults for BST activity in humans (Motzkin et al., 2015).

5. Deficient filtering of threat-related information from fronto-parietal working memory circuits, leading to elevated rumination over the past and increased worry about the future, may also contribute to context-independent negative affect (Stout, Shackman, Johnson, & Larson, 2014; Stout, Shackman, & Larson, 2013; Stout, Shackman, Pedersen, Miskovich, & Larson, 2017).

CHAPTER 5.3
1. Our friend and colleague, Dr. Jaak Panskepp (June 5, 1943–April 18, 2017), passed away just before this volume was published.

CHAPTER 5.9
1. This position is reminiscent of Lazarus’ suggestion that “emotion and cognition are each so complex and their mechanisms are spread so widely over the central and peripheral nervous system that, in my opinion, it is difficult to argue convincingly for separate systems as though there were a special brain organ for each” (Lazarus, 1991, p. 357).

CHAPTER 6.3
1. Note that in this essay I will not discuss the first portion of Wakefield’s definition related to cultural factors. Those interested are referred to (Lutz & White, 1986; Markus & Kitayama, 1991).

CHAPTER 7.4
3. Thanks to Ben Converse for this formalization.

CHAPTER 8.1
1. The terms “threat-related” or “threat-relevant” encompass a broad range of stimuli, including clear and immediate dangers (e.g., cues paired with shock), novel situations or individuals, uncertain or diffuse dangers (e.g., darkness), aversive stimuli (e.g., unpleasant images or films), and angry and fearful facial expressions. Angry faces signal a direct threat to the observer and prompt the mobilization of defensive responses, as indexed by potentiation of the startle reflex (Dunning et al., 2010; Hess, Sabourin, & Kleck, 2007; Springer et al., 2007), facilitation of avoidance-related movements (Marsh, Ambady, & Kleck, 2005), and increased fear ratings (Dimberg, 1988). In contrast, fearful faces signal the presence, but not the source of potential threat, and promote heightened vigilance in the absence of defensive mobilization. That is, static images of fearful faces do not amplify the startle reflex (Grillon & Charney, 2011; Springer et al., 2007) or autonomic measures (Dunsmoor, Mitroff, & LaBar, 2009). But they can increase subjective feelings of anxiety (Blairy, Herrera, & Hess, 1999) and are perceived as more threatening and arousing than neutral or happy faces (Grillon & Charney, 2011; Wieser & Keil, 2014).

CHAPTER 10.1
1. It is worth noting that Darwin (1872) stated that these opposing forms sometimes may not serve any function.
2. Calculated by using 20 facial action coding units, bilaterally where applicable, each of which may contract independently at five different levels of intensity.
3. An immediate physical utility distinguishes itself from the more distant social utility. Expression forms selected for social utility could also be considered “evolutionary” and functionally “ego-centric.” However, purely symbolic associated forms for social utility need not have any physical consequences.

CHAPTER 12.4
1. Surprise may also be considered to contain the fundamental property of unexpectedness that characterizes fear.

CHAPTER 12.5
1. Such as 2-alternative forced choice (2AFC) stimulus identification procedures: In 2AFC, the participant is asked to indicate a particular property of the stimulus in trials of “invisible” stimulus presentation (even if they claim they did not see the stimulus and thus are guessing)—for example, observers may report on whether a face was upright or upside down; or whether a facial expression was happy vs. fearful. This is in contrast with methods relying on subjective reports, such as when a participant is asked to
say “yes” or “no” to whether they saw a face. Different individuals have different response biases (e.g., different propensities to indicate that a stimulus is present given a particular sensory experience). Therefore, subjective measures may be confounded by response biases and are typically regarded as less conservative than 2AFC procedures (Wiens, 2006).

2. Note that the magnitude of amygdalar activation does not appear to be reliably modulated by conscious access to an emotional stimulus (Costafreda, Brammer, David, & Fu, 2008).

3. Replications cited include those of investigators adopting important procedural variations, such as alterations in the specific awareness manipulation method (including the original backward masking method, as well as interocular suppression and crowding), and the type of neutral target to be rated (originally a Chinese ideograph, and now, in several studies, a neutral face).

4. Note that awareness may not be required when cognitive control is not triggered implicitly but rather explicitly (Kunde et al., 2012), such as in the case of slowing down following a stop signal (van Gaal, Lamme, Fahrenfort, & Ridderinkhof, 2011), or switching a task set following a cue (Lau & Passingham, 2007).

5. Indeed, symptoms of degenerative disease to the LPFC are obvious if the patient has a job requiring mental flexibility and decision making, but not if s/he has a routinized job or lifestyle (Knight & D’Esposito, 2003).

CHAPTER 13.2

1. Here we use the term emotion as a catch-all. There are, of course, many affective states, which range from mood, to arousal, to true emotions. There is every reason to believe that all of these influence rationality and preferences in some way. We use the expression “emotion” in this brief essay as an exemplar for understanding how affective states in general influence decision-making.

2. Of course, if humans do become intransitive in some emotional states, then we need to be more creative in trying to understand the structure of their behavior. Under conditions in which a decision-maker is intransitive, a simple study of preferences will prove unsupportable mathematically. The economist David Laibson’s famous dual-process beta-delta model (Laibson, 1997) is one example of a structural model for dealing meaningfully with intransitive behavior.

3. GARP stands for the “Generalized Axiom of Revealed Preference,” developed by Hendrik Houthakker as a mathematical specification for what is probably the most common definition of full transitivity. For a more detailed explanation of this approach to transitivity, see Chapter 3, pp. 52–70, in Glimcher, 2010.

4. For simplicity, we completely neglect here the fact that apples and oranges, when bundled together in groups, may cause nonlinear utility interactions. This is a hugely important point taught to first-year economics students and called “substitution.” In the references to which we point, this is developed in some detail. But in order to convey the most basic concepts, we neglect it here.

5. For an economist, this is an important distinction because significant differences in the shape of the preference function in the gain and loss domain can imply a specific form of intransitivity, an important point, which we again neglect for simplicity.

6. As pointed out first by Kahneman and Tversky (1979), people in some situations behave according to distorted rather than objectively given probabilities, which we can capture by replacing p in the DEU equation with a probability weighting function w(p).

CHAPTER 15

1. Naturally, emotion researchers must remain mindful of measurement reliability in choosing between different within- vs. between-subjects designs (cf. Bradford, Starr, Shackman, & Curtin, 2015; Cannon, Cao, Mathalon, Gee, & NAPLS Consortium, 2018; Fox et al., 2012; Hedge, Powell, & Sumner, in press; Herting, Gautam, Chen, Mezher, & Vetter, in press).

2. From a clinical perspective, categorical approaches to diagnosing emotional disorders pose several critical barriers to discovering the nature and origins of psychopathology: rampant co-morbidity, low symptom specificity (e.g., insomnia), marked symptom heterogeneity, and poor reliability (Chmielewski, Clark, Bagby, & Watson, 2015; Clark, Cuthbert, Lewis-Fernandez, Narrow, & Reed, 2017; Fried, 2015, 2017; Fried & Nesse, 2019; Galatzar-Levy & Bryant, 2013; Goldstein-Piekarski, Williams, & Humphreys, 2016; Hasin et al., 2015; Kessler, Chiu, Demler, & Walters, 2005; Kotov et al., 2017; Krueger et al., in press; Olbert, Gala, & Tupler, 2014; Regier et al., 2013; Watson & Stasik, 2014). Addressing these problems requires a different kind of approach—one focused on narrower sets of transdiagnostic symptoms (e.g., anxiety, anhedonia)—as with the Hierarchical Taxonomy of Psychopathology (HiTOP) and Research Domain Criteria (RDoC) approaches (Clark et al., 2017; Kotov et al., 2017; Krueger et al., in press; Zald & Lahey, 2017). This ‘symptoms-not-syndromes’ dimensional approach (Fried, 2015) would also more naturally align with animal models (Fox & Kalin, 2014; Fox & Shackman, in press; Oler, Fox, Shackman, & Kalin, 2016). There is compelling evidence that traditional categorical approaches to diagnosing emotional disorders present several significant barriers to understanding the underlying mechanisms, including substantial...
symptom heterogeneity, frequent co-morbidity, and low inter-rater reliability (i.e., uncertain ‘ground truth’) (Fried, 2017; Galatzer-Levy & Bryant, 2013; Hasin et al., 2015; Regier et al., 2013). The adoption of narrower dimensional phenotypes is likely to provide useful (Kotov et al., 2017; Krueger et al., in press).

3. Aggression can be split on functional and neurobiological grounds into systems involved in defensive, offensive (predatory), and conspecific aggression, with the latter including maternal aggression and resource competition (food, mates, and territory/shelter) (Adams, 2006; Berkowitz, 1993; Nelson & Trainor, 2007). Naturally, researchers must remain mindful of measurement reliability in choosing between different experimental designs (e.g., within- vs. between-subjects); e.g., Bradford, Starr, Shackman, & Curtin, 2015; Cannon et al., 2018; Hedge, Powell, & Sumner, in press; Herting et al., in press; Larson et al., 2000; Shackman et al., 2017).

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