Afterword: *How are emotions, mood and temperament related?*

Alexander J. Shackman
Department of Psychology, Neuroscience and Cognitive Science Program, and Maryland Neuroimaging Center, University of Maryland, College Park, MD USA

Regina C. Lapate
Department of Psychology and Helen Wills Neuroscience Institute, University of California, Berkeley, CA USA

Andrew S. Fox
Department of Psychology and California National Primate Research Center, University of California, Davis, CA USA

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Address Correspondence to:
Alexander J. Shackman (shackman@umd.edu)
3123g BPS
Department of Psychology
University of Maryland, College Park, MD 20742 USA

All the authors seem to agree that emotions, mood, and temperament form a temporal continuum. Emotions and moods are transient, episodic states, but emotions are especially fleeting, lasting as little as a few seconds, whereas moods can endure for hours, even days. At the far end of this continuum, temperament and personality represent stable, trait-like tendencies or biases that slowly evolve over the course of months and years. The distinction between 'brief' emotions and 'sustained' moods is fuzzy and descriptive. In contrast with the first edition of the *Nature of Emotion*, none of the authors explicitly address the possibility of sustained emotions in the presence of longer-lasting challenges (e.g., exploring a novel, potentially dangerous environment; an extended fight with one's spouse).

Several authors describe other features that distinguish emotion from mood. Naragon-Gainey argues that they differ in their characteristic intensity, specificity, expression, and consequences: emotions are intense, whereas moods tend to be more mild; emotions are elicited by specific, overt challenges in the external environment, whereas moods are precipitated by internal, homeostatic changes (e.g., fatigue, hunger) or diffuse challenges (e.g., contexts associated with stress, potential danger, or conflict). Naragon-Gainey and Bowman & Fox emphasize that moods represent a persistent affective background on which emotions are superimposed. Both note that moods can bias attention, memory, and choice (see Question 8) and can lower the threshold or increase the intensity of congruent emotions (e.g., anger when feeling irritable, fear when feeling anxious).

Naragon-Gainey provides the most detailed account of features that distinguish emotion from mood. She notes that emotions are characterized by a relatively intense, but "loosely-coupled characteristic multimodal expression (e.g., physiological response, cognitions, behaviors, facial expressions)" (see also Reisenzein, Studtmann, & Horstmann, 2013), whereas moods manifest in more subtle expressions, such as posture or muscle tension. From a more functional perspective, she suggests that emotions and mood provide different kinds of information: "emotions primarily give information about our current

environment and moods primarily give information about our internal resources available to respond to current or potential demands." In other contexts, some theorists have emphasized that moods can also provide information about the statistical regularities in the external world—anxious mood may reflect exposure to an environment where threat is more probable or more difficult to accurately predict, irritable mood from hunger may indicate the absence of food (Nettle & Bateson, 2012).

While all of the authors agree that mood and temperament involve emotional states, there are striking differences in the precise nature of this arrangement. Naragon-Gainey suggests that the three constructs are linked by their basis in emotional experience and feelings, which gives rise to similar dimensional structures (e.g., positive and negative affect). For her, temperament reflects stable individual differences in the propensity to experience particular feelings and to engage in related thoughts and actions. Kagan and Blackford & Zald seem to hold a similar view. Bowman & Fox adopt the most radical position. Drawing on the work of LeDoux (LeDoux, 2012, 2014, 2015), they argue that temperament cannot be reduced to particular emotions or moods (e.g., fear or anxiety); that while there may be downstream consequences for emotions and mood, feelings do *not* form the core of temperament; and that the neural systems that underlie differences in temperament (e.g., circuits centered on the amygdala) are *not* specific to discrete emotions. Instead, they view temperament as reflecting, at least in part, neurobiological systems sensitive to threat, reward, and other phylogenetically ancient, motivationally significant challenges. It remains to be seen whether this perspective has substantive implications for research aimed at understanding the biological bases of emotions, mood, or temperament.

Many of the authors emphasize the importance of regulatory processes. Naragon-Gainey highlights ways in which they can alter the intensity of momentary emotions and help transform fleeting emotions into sustained moods (e.g., via a failure to regulate or maladaptive rumination on the past). She also indicates that characteristic individual differences in emotion regulation also contribute to temperament. B&F

review the importance of regulatory processes to temperament, but emphasize the importance of automatic (e.g., attentional biases) and controlled (e.g., conflict monitoring) cognitive processes that are not specific to the regulation of emotion or mood. Along broadly similar lines, Blackford & Zald make the case that temperament reflects variation in the function of at least two kinds of neural circuits, some involved in triggering or orchestrating emotional states (e.g., amygdala) and others involved in the adaptive control of emotion and cognition (e.g., orbitofrontal cortex, dorsolateral prefrontal cortex, anterior cingulate; for related perspectives, see Questions 7 and 8).

Several authors highlight the challenges of dissecting emotions and mood from temperament. Blackford & Zald remind us that emotions and temperament are often defined in ways that are circular—temperament causes emotions, emotions cause temperament—making it difficult to parse the two in the brain or other measurable systems (e.g., verbal report). Naragon-Gainey reminds us that assessments of emotional traits, like temperament and personality, are invariably contaminated by momentary fluctuations in mood and emotion. Conversely, assessments of emotions and mood are influenced in important ways by trait-like individual differences in temperament. While not addressed directly, this problem is not specific to verbal report; there is ample evidence that it influences biological measures as well (Gee et al., *in press;* Hagemann, Hewig, Seifert, Naumann, & Bartussek, 2005; Tomarken, 1995). As she notes, a key challenge for the field is to adopt statistical tools that can quantify the relative contributions of state and trait variance.

Finally, echoing other commentators (Adolphs, *in press;* Block, 1995; Bradley & Lang, 2007), Kagan cautions that isolated measures of emotions—whether verbal, behavioral or biological—often fail to detect emotions when they are present and can reflect multiple emotional or even non-emotional processes (i.e., suffer from insufficient sensitivity and specificity). Instead, he argues that a multivariate

approach will be most helpful for understanding the mechanisms underlying emotions, mood, and temperament (for related views, see Lang & Bradley's and Adolphs' response to Question 1).

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