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The Hundred-Year Emotion War: Are Emotions Natural Kinds or Psychological Constructions? Comment on Lench, Flores, and Bench (2011)

Kristen A. Lindquist[1], **Erika H. Siegel**[2], **Karen S. Quigley**[2,3], and **Lisa Feldman Barrett**[2,4]
[1]University of North Carolina, Chapel Hill

[2]Northeastern University

[3]Edith Nourse Rogers Memorial (VA) Hospital, Bedford, MA

[4]Massachusetts General Hospital/Harvard Medical School/Martinos Center for Biomedical Imaging

Abstract

For the last century, there has been a continuing debate about the nature of emotion. In the most recent offering in this scientific dialogue, Lench, Flores, and Bench (2011) report a meta-analysis of emotion induction research and claim support for the natural kind hypothesis that discrete emotions (e.g., happiness, sadness, anger, and anxiety) elicit specific changes in cognition, judgment, behavior, experience, and physiology. In this paper, we point out that Lench et al. (2011) is not the final word on the emotion debate. First, we point out that Lench et al.'s findings do not support their claim that discrete emotions organize cognition, judgment, experience, and physiology because they did not demonstrate emotion-consistent and -specific directional changes in these measurement domains. Second, we point out that Lench et al.'s findings are in fact consistent with the alternative (a psychological constructionist approach to emotion). We close by appealing for a construct validity approach to emotion research, which we hope will lead to greater consensus on the operationalization of the natural kind and psychological construction approaches, as well as the criteria required to finally resolve the emotion debate.

Keywords

emotion; natural kinds; psychological construction; construct validity; meta-analysis

For as long as scholars and scientists have been writing about the human mind, they have been speculating on the nature of emotion. There has been consensus (more or less) that emotions are evolved tools for dealing with the challenges of human life. There is also widespread agreement that an "emotion" refers to some change in subjective experience, autonomic responses (e.g., heart rate, respiration, electrodermal activity), physical action (or an increased likelihood to perform an action, such as facial muscle movements, skeletal muscle movements, etc.), as well as some perception, thought, or judgment of the surrounding world. Beyond these points, however, the science of emotion is fraught with disagreement (cf., Gross & Barrett, 2011). One issue that has persisted over the last century is whether or not certain emotion categories (named with the English words: anger, sadness, fear, disgust, happiness, etc.), that are typically referred to as "discrete emotions," exist in

Address correspondence to: Kristen A. Lindquist, University of North Carolina, Chapel Hill, Department of Psychology, Davie Hall, Chapel Hill, NC 27599, kristen.lindquist@gmail.com.

nature, independent of a human perceiver. This debate amounts to the question of whether or not these emotions are natural kind categories with firm biological boundaries (cf., Barrett, 2006a). To suggest that emotions are natural kinds is to hypothesize that each category has a biological essence that causes it or that the instances have some cluster of properties (i.e., coordinated changes in sensory, perceptual, motor, and physiological functions) that recur with sufficient consistency and specificity as to be diagnostic for that category. The alternative view, if specific profiles cannot be found for each emotion category, is that emotions must be inventions (i.e. constructions) of the human mind. This is not a claim that emotions are illusions, but rather that they are complex perceptions, and it is therefore necessary to explain how the categories are acquired and the processes by which the perceptions (i.e., the instances of each category) materialize (cf., Barrett, in press).

Over the last century, the emotion debate has been fought like a series of battles that resemble something like the Hundred Years' War between England and France. In the history of psychology, emotions were initially treated as natural kinds (Darwin, 1872/1965), as constructed events (James, 1884; Wundt, 1897/1998) and then as natural kind categories again (McDougall, 1928; J. B. Watson, 1919). A few decades later, review papers failed to find support for the natural kind view of emotion in the experimental literature (Duffy, 1934; Hunt, 1941), but within two decades, theoretical works again asserted a natural kind view (Arnold, 1960; Tomkins, 1962). On it went, each side winning a battle, but never winning the war (e.g., Ekman, 1972; Mandler, 1975; Matsumoto, 1990; Ortony & Turner, 1990; Panksepp, 1998). Most recently, we and others reviewed the existing empirical evidence and questioned whether emotions are natural kinds (Barrett, 2006a, 2011b; Barrett et al., 2007; Lindquist, Wager, Bliss-Moreau, Kober, & Barrett, in press; Lindquist, Wager, Kober, Bliss, & Barrett, in press; Mauss & Robinson, 2009), instead proposing a psychological constructionist approach to understanding the nature of emotion (Barrett, 2006b, 2009, 2011a; Kirkland & Cunningham, in press; Russell, 2003; Wilson-Mendenhall et al., 2011); other models that share similar assumptions but have not been explicitly labeled as psychological constructionist models, have also recently emerged (e.g., Boiger & Mesquita, in press; Clore & Ortony, 2008; Coan, 2010; LeDoux, 2012). In the August, 2011 issue of *Psychological Bulletin*, Lench, Flores, and Bench reported a meta-analysis of 687 studies, claiming support for the natural kind approach to emotion by concluding that "emotions are evolutionarily adaptive responses that serve to organize cognitive, judgment, experiential, behavioral, and physiological reactions to changes in the environment" (p. 849). They further reported that the pattern of results observed across studies did not support what they referred to as a "dimensional" approach to emotion, which they described as an attempt to reduce emotions to variations in hedonic valence and arousal. The question we ask in this paper is whether Lench et al.'s meta-analysis is the definitive word on the matter, or merely another battle in the Hundred-Year Emotion War?

Although we applaud Lench and colleagues' (2011) Herculean meta-analytic effort to resolve the great emotion debate, we suspect that their conclusions are not the final word on the matter. This is because, despite Lench et al.'s claims, (1) their meta-analysis did not actually show strong support for a natural kind view and (2) their findings do not convincing refute the alternative view. To demonstrate these points, we begin our paper by outlining the empirical criteria that are required to support the claim that emotions are natural kind categories, and consider whether the results in Tables 1–4 in Lench et al. (2011) demonstrate these criteria. Next, we discuss the paper's characterization of the so-called "dimensional approaches" and note limitations in their formulation; specifically, we point out that a discussion of affective dimensions in emotion (such as valence and arousal) is incomplete without a broader consideration of how affect is transformed into discrete emotional episodes (e.g., see Barrett, 2006b; Clore & Ortony, 2008; Harlow & Stagner, 1932; James, 1890; Mandler, 1975; Russell, 2003; Schachter & Singer, 1962; Wundt, 1897/1998). We

then point out that the results in Table 1–4 cannot effectively rule out a psychological constructionist account of the data, and upon closer inspection actually appear to support it. In a final section of our commentary, we outline a construct validity approach that we believe would be more instructive for resolving the great debate over the nature of emotions.

The Discrete Emotion Hypothesis

In their meta-analysis, Lench and colleagues (2011) take advantage of a common dichotomy within the science of emotion, which they refer to as the "discrete emotion" vs. "dimensional" alternatives. In the "discrete emotion" approach that Lench et al. describe, select emotion categories are assumed to reflect natural kind categories that are psychologically and biologically finite and separable mental events.[1] Lench et al. tested the proposition that, "each discrete emotion elicits changes in cognition (e.g., narrowing of attention on a tiger in the distance), judgment (e.g., the risk perceived in the environment), experience (e.g., the recognition that one is afraid), behavior (e.g., a tendency to run away), and physiology (e.g., increased heart rate and respiration)," (p. 835). This is essentially a stimulus-response approach to emotion, with the idea that a stimulus (either its physical properties, or a person's cognitive evaluation of the stimulus) triggers an emotion, which in turn causes a coordinated change in experience, behavior, and physiology. Their discrete emotion approach assumes that, mechanistically, the emotion itself is separate from the reactions it causes, meaning that all instances of the same emotion must have some kind of common mechanism that makes them the kind of emotion they are. Their model also assumes that the effects of emotion (subjective experience, behavior, physiology, etc.) can be used to diagnose the presence of the emotion.

Empirical Criteria: Consistency and Specificity

Lench et al. (2011) claim that their primary goal is to evaluate the extent to which existing evidence is consistent with "discrete emotions" (a.k.a. the natural kind view of emotion) (p. 834). To properly test this view, it would be necessary to assess the extent to which emotion inductions for each category consistently produced a specific change in the outcome measures. Consistency refers to the fact that changes in outcome measures are replicable—they occur for each and every instance of the emotion. Specificity refers to the fact that changes in outcome measures are unique—they occur for one emotion and only that emotion (for a discussion of consistency and specificity of meta-analyses of the emotion literature, see Barrett & Wager, 2006; Lindquist, Wager, Kober, et al., in press). A meta-analysis must therefore make specific, directional hypotheses about each emotion category, proposing specific patterns of responses for each emotion, for each clearly operationalized dependent measure. For example, one hypothesis might be that the experience of anger will lead to: heuristic processing (cognition) (Bodenhausen, Sheppard, & Kramer, 1994), decreases in inhibitory responses (behavior) (see Carver & Harmon-Jones, 2009), decreases in perceived risk (judgment) (Lerner & Keltner, 2001), and increases in heart rate and skin temperature (physiology) (Ekman, et al., 1983). This pattern would be distinct from the hypothesized pattern for fear (or anxiety) and disgust (i.e., other high arousal, unpleasant emotions), sadness (i.e., a low arousal, unpleasant emotion) and happiness (i.e., a pleasant emotion). Rather than testing for specific directional patterns within an emotion category (e.g., that the pattern for anger is consistent across studies but distinct from the pattern for anxiety), however, Lench and colleagues tested the hypothesis that each emotion category is associated with any unspecified change in cognitive, behavioral, experiential, judgmental and physiological measures.[2] Given the way the results are reported we cannot know the

[1]The emotions that are hypothesized to be natural kinds differ by theorist, but typically include six categories (e.g., surprise, anger, fear, sadness, happiness, and disgust; Ekman et al., 1987; Ekman, Levenson, & Friesen, 1983). All discrete emotion accounts, to our knowledge, include "fear" as a discrete emotion, in contrast to the category "anxiety" included by Lench et al. (2011).

consistency and specificity of the results from each outcome domain: an effect size of .55 for the anger vs. neutral comparison could mean that physiological activation went up during the anger induction in some studies but down in others (relative to a neutral induction).

A discrete emotion view also requires showing specificity within individual measures of each broad measurement domain (e.g., physiology). For instance, heart rate, cardiac impedance, respiration rate, skin conductance, and facial electromyography are all physiological measures, but each provides very different information about what is occurring in the body at one point in time. Moreover, these different physiological variables are not themselves always correlated in time and intensity (e.g., Lacey, 1967; Lang, 1968; Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005) (see Barrett, 2006a for a review), so there is limited utility in summing measures into a single "physiological" variable. For instance, an increase in heart rate is sometimes accompanied by an increase in total peripheral resistance, but at other times, a decrease (e.g., Tomaka, Blascovich, Kelsey, & Leitten, 1993; Tomaka, Blascovich, Kibler, & Ernst, 1997). The importance of testing for patterns of consistent and specific physiological responses for different discrete emotion categories is not new (e.g., Christie & Friedman, 2004; Kreibig, 2010; Stemmler, 1989, 2001; Stephens, Christie, & Friedman, 2010), and specific patterns have been hypothesized in prior research (e.g., Ekman, et al., 1983; Kreibig, Wilhelm, Roth, & Gross, 2007; Lerner, Dahl, Hariri, & Taylor, 2007). This is a high bar to reach, of course, but it is the one that is set by the theoretical writings about discrete emotion models (e.g., Ekman, 1999; Izard, 2011; Kreibig, 2010; Levenson, 2011; Oatley & Johnson-Laird, 2011; Ohman & Mineka, 2001; Roseman, 2011). A similar point can be made for other measurement domains (e.g., behavior, cognition, etc.) assessed in Lench et al.'s meta-analysis.

The bottom line is that the Lench et al. (2011) paper is useful for demonstrating that emotion inductions produce some magnitude of change in cognition, judgment, behavior, experience, or physiology, but the nature and specificity of those changes for each emotion category is left unspecified. As a result, their findings do not address whether specific emotions have diagnostic clusters of outputs, as is hypothesized by the discrete emotion models cited in their paper. Moreover, their findings do not say anything specific about emotions as distinguished from say, motivational changes, or changes associated with thoughts, perceptions, or memories. To adequately test the hypothesis that emotions, but not other types of mental states, consist of correlated packages of cognition, behavior, physiology etc., a meta-analysis would have to compare studies of emotions to studies of these other mental state categories.

Pairwise Comparisons do not Reveal Strong Evidence for Discrete Emotions

If we disregard concerns about consistency and specificity, and simply judge the Lench et al. (2011) meta-analysis on its own terms, using their fairly broad criteria, then we still do not observe strong evidence for a discrete emotion view. As Lench and colleagues suggest (pp. 835 and 846), the most diagnostic comparison for a discrete emotion approach in their meta-analysis would be between anger and anxiety, since both are high-arousal, unpleasant emotions (Russell, 1980). Yet, according to Lench et al.'s Table 1, the average effect size for this comparison is quite small (.13) as compared to other negative emotion comparisons where the induced emotions differ in arousal (anger vs. sadness = .27; anxiety vs. sadness = .26) or where the induced emotions differ in valence (happiness vs. sadness = .68; happiness

[2]This sort of comparison would be sufficient if they were evaluating whether emotions differ from say, other affective or cognitive states (e.g., do emotions involve correlated changes in cognition, behavior, experience and physiology whereas hunger or memory do not?). But the authors did not include other types of affective and mental states as comparisons. Instead, their goal was to understand whether individual emotions are natural kind categories.

vs. anger = .70; happiness vs. anxiety = .96) (see Figure 1). Furthermore, the psychophysiological outcomes, which are the least subject to demand characteristics and are the most relevant theoretically if emotions are to be considered biological categories, do not provide evidence for the natural kind view of anger and anxiety. Lench et al.'s Table 3 indicates that anger and anxiety inductions did not differ in effect size for physiological measures across 27 studies (.06, ns). Interestingly, none of the negative emotion inductions differed from one another on physiological measures (anger vs. sadness across 14 studies = .19, ns; anxiety vs. sadness across 20 studies = .11 $p < .10$, anger vs. anxiety across 27 studies = .06, ns; see Table 3). Nor did any of these inductions differ in terms of measured behavior (anger vs. sadness across 6 studies =−.18, ns; anxiety vs. sadness across 4 studies = −.12 ns; anger vs. anxiety across 5 studies = .20, ns; see Table 3). The observation that the most robust physiologic and behavioral differences are found for cross-valence comparisons is consistent with prior meta-analyses (Cacioppo, Berntson, Larsen, Poehlmann, & Ito, 2000) and the conclusions of recent reviews (Barrett, 2006a; Mauss & Robinson, 2009).

The only consistently significant differences (with moderate effect sizes) across pairwise comparisons of negative emotion inductions in Lench et al.'s (2011) meta-analysis were observed for self-reported emotional experience (effect sizes range from .24–1.61, p's<.001; see Table 3). The fact that participants report differences in experience across different emotion inductions, but do not show consistent and specific differences in physiological responding and behavior, is more consistent with the alternative hypothesis that emotions are constructions of the human mind—complex perceptions where physiological responses are made meaningful in context. We discuss the psychological constructionist approach in more detail in the next section.

The Psychological Construction Hypothesis

In the science of emotion, writers often contrast a discrete emotion hypothesis with what they refer to as a "dimensional" hypothesis. As typically characterized by those who take a discrete emotion approach, dimensional views reduce emotions to general affective dimensions of hedonic *valence* and *arousal* (Barrett & Bliss-Moreau, 2009; Russell, 1980; Russell & Barrett, 1999), *positive* and *negative activation* (D. Watson & Tellegen, 1985; D. Watson, Wiese, Vaidya, & Tellegen, 1999), *positive* and *negative affect* (Cacioppo, Gardner, & Berntson, 1999), *approach* and *withdrawal* (Davidson, 1992; Lang & Davis, 2006), or *tense* and *energetic activation* (Thayer, 1989). Lench et al. (2011) provide a good example of this rhetorical device when they wrote "valence or valence combined with arousal captures the important differences among emotions," (p. 835). The problem with this description, however, is that to our knowledge, "dimensional models" do not claim that valence and arousal provide a *sufficient* account of all the important differences among emotions.

Affect (in one form or another) is indeed a common feature of psychological constructionist models of emotion (Barrett, 2006a, 2006b, 2009, 2011a, 2011b; Duffy, 1941; Clore & Ortony, 2008; Harlow & Stagner, 1932; Mandler, 1975; 1990; Russell, 2003; Schachter & Singer, 1962; Wundt, 1897/1998). But the hypothesis is that valence and arousal are *necessary* elements in emotion, and that some additional meaning-making process is needed to make psychological sense of these general affective changes for discrete emotions to emerge.[3] This meaning analysis is described as using ideas (Wundt, 1897/1998), social

[3]While it is true that the earlier papers cited by Lench et al. discussing the affective circumplex focused on what could be learned about emotion from a two-dimensional approach, such work does not imply that other properties of emotion are unimportant. Similarly, in the study of vision, targeted studies of one psychological property (e.g., color) do not imply that others (such as contrast, brightness, etc.) are unimportant.

referencing (Schachter & Singer, 1962), attribution, (Russell, 2003), appraisals (Clore & Ortony, 2008), or situated conceptualizations (Barrett, 2006b) and is hypothesized to proceed automatically with little sense of agency or effort. Lench et al. attempt to acknowledge the role of meaning making by characterizing the "dimensional" view as one where the discreteness in emotions is hypothesized to arise from "cultural expectations" (p. 835), learned "preconceptions" (p. 844), or "beliefs" (p. 835) that perceivers wield with some degree of conscious intent (p. 844). The problem is that most psychological construction views do not describe meaning making in these volitional, declarative terms. This point is made clearly in the surge of articles on psychological constructionist models of emotion that have been published in the last decade, which outline how affective states of valence and arousal are transformed into instances of emotion (Barrett, 2006a, 2006b, 2009, 2011a, in press; Barrett, Lindquist, Bliss-Moreau, et al., 2007; Barrett, Lindquist, & Gendron, 2007; Barrett, Mesquita, Ochsner, & Gross, 2007; Barrett, Ochsner, & Gross, 2007; Clore & Ortony, 2008; Gross & Barrett, 2011; Kirkland & Cunningham, in press; Lindquist & Barrett, 2008a, 2008b; Lindquist, Wager, Bliss-Moreau, et al., in press; Lindquist, Wager, Kober, et al., in press; Russell, 2003; Wilson-Mendenhall, Barrett, Simmons, & Barsalou, 2011). Other models of emotion that are not explicitly identified as psychological constructionist views but that share some of this tradition's assumptions have also emerged (e.g., Boiger & Mesquita, in press; Coan, 2010; LeDoux, 2012).

In a psychological construction framework, emotions are not special mental states with diagnostic patterns of output. Instead, the hypothesis is that an emotion word names a commonsense category that corresponds to a wide range of mental events that vary in physiology, behavior, cognition, and experience. For example, when angry, a person might sometimes yell and feel the urge to aggress, and blood pressure might sometimes rise (say, when another driver cuts you off in traffic). But not all instances of an emotion referred to by the same word (e.g., "anger") look alike, feel alike, or have the same neurophysiological signature. A person might calmly re-explain a rule to a disobedient child, turn off the radio when the voice of a disliked politician is heard, sit very still and perhaps even smile when insulted, or tease a friend instead of criticize. During these instances, the person's blood pressure, heart rate and skin conductance level might each go up, or down, or stay the same. In this view, emotions are not privileged mental states, unique in form, function, and cause, from other mental states such as cognition and perception. Emotions are not said to be "caused" by dedicated mechanisms, but instead emerge from an ongoing constructive process that involves a set of more basic psychological "ingredients" that are not, themselves, specific to emotion (Barrett, 2006b, 2009, in press; Boiger & Mesquita, in press; Clore & Ortony, 2008; Coan, 2010; Lindquist & Barrett, 2008a; Lindquist, Wager, Kober, et al., in press).

Thus, psychological constructionist accounts of emotion actually integrate dimensional and categorical perspectives. As we discussed in Barrett, Lindquist, et al. (2007), the dimensional aspect can be found in the hypothesis that all emotional events, at their core, have affective properties that are experienced as pleasant or unpleasant, arousing or quiescent (although the neural states that instantiate affective changes are numerous and varied). The categorical aspect can be found in the hypothesis that people automatically and effortlessly categorize the ebb and flow of core affective changes using some kind of meaning making process. Meaning making performs a kind of figure-ground segregation, so that the experience of an emotion, or a perception of an emotion, will pop out as a separate event from the ebb and flow in ongoing core affect (in which core affect is associated with the direction and urgency of initial behavioral responses). In doing so, people automatically divide ongoing changes in core affect into meaningful and distinct experiences.

Given that people make meaning of affective changes in different ways across different contexts, we would not expect there to be a single "signature" for anger (or for sadness, fear, or for disgust, etc.). Instead, the observed patterns that occur would be highly tuned to the context. Research that is designed to assess the impact of context appears to bear this hypothesis out (Kreibig, 2010; Stemmler, 1989, 2001; Wilson-Mendenhall, et al., 2011).

That being said, to the extent that emotion concepts are embodied (Barrett, 2006b; Niedenthal, 2007; Niedenthal, Barsalou, Ric, & Krauth-Gruber, 2005; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Oosterwijk, Rotteveel, Fischer, & Hess, 2009; Oosterwijk, Topper, Rotteveel, & Fischer, 2010), sensorimotor changes (or their representation in the brain) might help constitute, rather than result from, an emotional response. A person living in a certain cultural context might have learned to associate certain instances of fear with certain bodily changes (e.g., fear of dangerous objects might be associated with increased heart rate, wide eyes, and behavioral avoidance), and these sensorimotor representations would in part constitute the concept of "fear" (cf. Barrett, 2006b). When this concept knowledge is used in the future to help make meaning of an affective change in a particular context (e.g., when encountering a dangerous object), its embodied nature could actually direct particular bodily activations (e.g., an increase in heart rate), such that via grounded cognition, the concept "fear" induces the pattern of physiological changes (e.g., Oosterwijk, et al., 2010). Of course, future research is required to test this hypothesis, but if emotion concepts are embodied then it is possible that more prototypical instances of emotion (i.e., the concepts most easily and frequently learned by children; e.g., anger where you approach someone) will have a more consistent pattern of bodily activity associated with them than non-prototypical instances (e.g., anger where you avoid someone). Such a possibility implies, of course, that emotion-consistent and emotion-specific patterns of response could be the result of learning. This scenario is consistent with some recent discrete emotion views acknowledging the role of learning in emotional responding (e.g., Ekman & Cordano, 2011; Izard, 2011). It also means that merely showing a specific and consistent pattern of responding for an emotion category is not enough to support all the aspects of a discrete emotion view. It would also be necessary to refute alternative explanations for such patterns by showing that patterns are inborn and inherited.

Although we are reluctant to draw a firm conclusion about the nature of emotion based on the findings reported by Lench et al. (2011), their results do appear to be consistent with the psychological constructionist hypothesis that emotions emerge from more basic psychological "ingredients" such as affect and conceptualization. First, the effect sizes for emotion inductions of different valence are much larger than those for emotions that share valence or arousal properties (see Figure 1). For example, a multi-method, multi-emotion approach (based on the multi-method, multi-trait logic of Campbell & Fiske, 1959) reveals that the effect sizes associated with negative emotion comparisons are considerably smaller than the effect sizes associated with different induction methods, meaning that the methods used to induce emotions carry more variance than the discrete emotion constructs themselves (see Table 1). On the other hand, the effect sizes associated with emotion comparisons that differ in valence (e.g., positive v. negative affect), are either as large or larger than the effect sizes associated with different methods, meaning that valence carries more variance than the methods used to induce emotion. These findings counter Lench et al.'s assertion (p. 850) that they have ruled out valence and arousal as alternate explanations for their findings.

Of course, as we note above, a full picture of the nature of emotion is not complete in a psychological constructionist view without a discussion of the role of conceptualization, which transforms instances of affect into experiences of anger, fear, disgust and so on. Interestingly, we also observe some evidence for the role of conceptualization in the Lench

et al. (2011) meta-analytic findings. When comparing negative emotion inductions (Table 3), significant effect sizes occur in measurement domains that have the strongest link to conceptualization (self-reported experience, cognition, and judgment) but not in domains with a weaker link to conceptualization such as physiology. It is not possible to tell from this meta-analysis whether different inductions involved more or less conceptualization, but explicitly modeling the role of conceptualization in emotion inductions is an important avenue of future research.

Ending the Hundred-Year Emotion War

We are being a bit tongue-in cheek when we compare the science of emotion to the Hundred Years War, but jokes often contain a grain of truth. Like many wars, the Hundred Years War brought with it great innovation and social change amidst the pain and misery it caused. And so it is with the great debate in the science of emotion. Key methodological advances and scientific discoveries have been made during the clash of competing viewpoints over the past century. But conflicts must eventually resolve so that people can enjoy the fruits of hard won scientific accomplishments. In the end, we disagree with Lench et al. (2011) that there is "increasing agreement" about the nature of emotion in scientific research (pp. 835, 849). The number of recent papers and reviews questioning the nature of emotion indicates that we are still in the midst of a great emotion debate (e.g., Barrett, 2006a, 2006b, 2011b, in press; Barrett, Lindquist, Bliss-Moreau, et al., 2007; Barrett, Lindquist, & Gendron, 2007; Clore & Ortony, 2008; Coan, 2010; LeDoux, 2012, in press; Lench, Flores, & Bench, 2011; Lindquist, Wager, Bliss-Moreau, et al., in press; Lindquist, Wager, Kober, et al., in press; Mauss & Robinson, 2009; Panksepp, 2007; Russell, 2003; Vytal & Hamann, 2010). And regardless of whether or not there is growing agreement amongst scientists, the most important issue is whether models agree with the data in hand.

Part of resolving a scientific debate is making sure that the right questions are being asked. In our view, the issue is not, as Lench et al. (2011) state, that there is "disagreement about which emotions are discrete and represent independent categories of emotional experience" or whether "emotions represent discrete constructs beyond their valence and arousal" (p. 838). No scientist or layperson would ever claim that a feeling of anger is the same as a feeling of fear, or that both feelings can merely be reduced to the fact that they are both unpleasant and high in arousal. The real question is what makes subjective feelings of anger and fear different from one another? Do the differences exist in the head of a perceiver or can they be found in "objective" measures (i.e., perceiver-independent data such as autonomic, brain imaging, or facial electromyographic data)? Put another way: is one instance of anger more similar to another instance of anger than both are to two different instances of fear? If such regularity exists, can it be found in perceiver-independent data (such as autonomic, brain imaging, or facial electromyographic data), which would provide evidence for objective differences between instances of emotion categories, or does the regularity exist in the head of the perceiver? If the latter is true, then emotions are still real, but they are part of social reality (rather than being natural kinds) and this calls for a radically different paradigm to study them (Barrett, in press).

A Construct Validity Approach to Emotion

In 1948, as psychology was starting to struggle its way free from behaviorism, MacCorquodale and Meehl (1948) introduced a powerful idea into psychology: the hypothetical latent construct. A latent construct was a process or event whose existence must be inferred based on a set of observed empirical relations between measurements. Within a decade, Meehl had proposed a formal approach—the construct validity approach—for testing hypotheses about latent psychological constructs (Cronbach & Meehl, 1955). A construct validity approach requires a clear operationalization of how observable

measurements must configure to demonstrate the existence of the latent construct in question. In the science of emotion, this would require scientists to be explicit and precise about how they operationalize anger, fear, sadness, etc. in terms of the measures they are taking and to use the appropriate measurement model to test their hypotheses.

If emotions are hypothesized to be natural kinds, then scientists would operationalize emotions using an effect indicator model, where a latent construct (e.g., anger) is measured as the correlation of observable outcomes (e.g., physiological changes, cognitions, behaviors, etc.) (for a discussion see Barrett, 2000, 2006a; Barrett, 2011a; Coan, 2010). In an effect indicator model, the measured observable outcomes correlate with each other perfectly (barring measurement error) because they have a common cause (i.e., the emotion). The measures are thus said to "reflect" the latent construct and their correlations are taken as evidence that the hypothetical construct exists (because it cannot be measured directly by its nature or given the limits of existing measurement tools or methods). In construct validity terms, convergent validity for a natural kind model of an emotion (e.g., anger) would be achieved when certain observable outcomes (e.g., an increase in heart rate, activity in the corrugator muscle, decreased estimates of risk, behavioral approach, reports of "anger") correlate highly in time and intensity across instances. Discriminant validity would be achieved if the same set of observable outcomes did not correlate across instances of a different emotion (e.g., fear). In a meta-analysis like Lench et al.'s (2011), construct validity would be achieved for a natural kind model if inductions of say, "anger," actually caused consistent and specific changes in various cognitions, various physiological systems, and multiple behaviors, across contexts within an individual and across individuals, *and* if that pattern of changes is specific to anger (and thus, does not occur during the experience of other emotions). It is not sufficient to reject the null hypothesis based on *any* significant difference between emotions.

If emotions are psychological constructions, then scientists might operationalize emotions using a causal indicator model, in which the latent construct (e.g., anger) is an abstract construct that is constituted by the linear combination of the observable variables (e.g., physiological changes, cognitions, behaviors, etc.) (for a discussion see Barrett, 2011a; Coan, 2010). It is not necessary for the observed variables to correlate. Instead, each measure is expected to contribute unique variance to the construct, so that any variation in any one of the measures (not due to measurement error) will produce a change in the latent construct itself (because the latent construct is at least the sum of these more basic parts). Convergent validity is achieved if an emotion construct (e.g., anger) results from a specific combination of measurable variables (e.g., feelings of unpleasant, high arousal affect and concept knowledge about "anger") in a specific context, and if this pattern is replicable in that context for that person. If different patterns are observed in different contexts, or for the same context but in different people, this does not threaten the convergent validity of the latent emotion construct. Psychological construction allows that instances of different emotions (e.g., anger and fear) can have similar patterns of objective measurement (e.g., heart rate, skin conductance, facial electromyography). Discriminant validity thus rests on the measurement of perceiver-based knowledge: if category knowledge about anger is used when someone is experiencing or perceiving fear, then this would be a failure to achieve discriminant validity for a psychological construction model. To conduct an appropriate meta-analytic test of a psychological construction model, one would need to evaluate the extent to which affective changes and conceptualization each contribute to emotional events (e.g., Lindquist et al., in press).

Conclusion

Although Lench et al. (2011) is unable to provide a definitive answer on the nature of emotion, it nonetheless contributes important information by demonstrating that emotion inductions are not psychologically inert – it is possible to push around thoughts, feelings, bodily states, and behaviors in the lab. Such findings counter arguments that emotions cannot be effectively induced in the lab or that lab-based emotions somehow pale in comparison to what occurs in everyday life. Furthermore, it provides scientists with a valuable resource for selecting the most effective emotion induction techniques for future research. We are grateful for this, and our own research will benefit greatly from their labors.

Lench et al. (2011) is also a useful reminder that as scientists, we must hold ourselves to what seem at times the impossible standards set by Cronbach and Meehl (1955). The criticisms we have discussed here are by no means specific to the Lench et al. paper. The difficulties in their paper are a symptom of a larger, more pervasive problem that plagues the study of emotion: scientists are often fuzzy when it comes to operationalizing what would confirm or disconfirm their own models. We have hope, however, that if the field adopts a construct validity approach, we might finally resolve the great debate on the nature of emotions.

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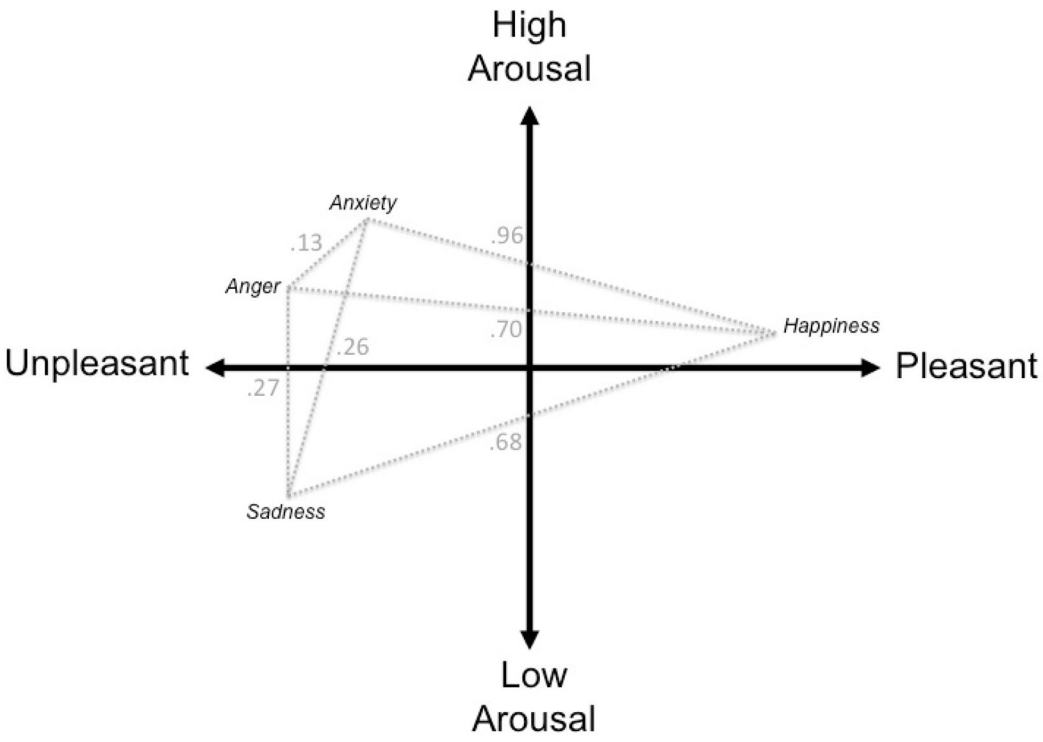

Figure 1.
The findings of Lench et al.'s (2011) pairwise comparisons between emotions can be accounted for by differences in valence and arousal between emotions. Emotion categories are depicted in a circumplex structure based on their average degree of valence and arousal. Effect sizes for each paired comparison are listed. The largest effect sizes occur for cross-valence comparisons, followed by cross-arousal comparisons. The smallest effect size observed is between anger and anxiety, emotions of the same valence and arousal.

Table 1

Multi-emotion, multi-method analysis of Lench et al.'s (2011) findings

	Within-valence			Cross-valence			
	Anger v. Anxiety	**Anger v. Sad**	**Anxiety v. Sad**	**Happy v. Sad**	**Happy v. Anger**	**Happy v. Anxiety**	**Effect size$_{method}$**
Imagine	0.24	0.18	0.3	0.72	0.55	1.08	0.51
Recall	0.05	0.36	0.4	0.49	0.59	0.77	0.45
Velten	−0.08	0.1	0.23	0.74	0.26		0.51
Music	0.34	0.3	0.47	0.66	1.16	1.87	0.53
Film	−0.05	0.16	0.22	0.88	0.87	1.08	0.6
Pictures	−0.02		0.43	1.02	0.17	2.04	0.81
Behavior	0.12	0.21	0.18	0.48	1.03	0.68	0.47
Real	0.03	−0.19		0.54	0.94	0.1	0.46
Effect size$_{emotion}$	0.13	0.27	0.26	0.68	0.70	0.96	

Note: Effect sizes (g) derived from Tables 1 and 4 in Lench et al. (2011)