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Basic Emotion Questions

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Abstract

Among discrete emotions, basic emotions are the most elemental; most distinct; most continuous across species, time, and place; and most intimately related to survival-critical functions. For an emotion to be afforded basic emotion status it must meet criteria of: (a) distinctness (primarily in behavioral and physiological characteristics), (b) hard-wiredness (circuitry built into the nervous system), and (c) functionality (provides a generalized solution to a particular survival-relevant challenge or opportunity). A set of six emotions that most clearly meet these criteria (enjoyment, anger, disgust, fear, surprise, sadness) and three additional emotions (relief/contentment, interest, love) for which the evidence is not yet quite as strong is described. Empirical approaches that are most and least useful for establishing basic-emotion status are discussed. Basic emotions are thought to have a central organizing mechanism and to have the capacity to influence behavior, thoughts, and other fundamental processes.

Keywords
basic emotions, discrete emotions, emotional language, evolutionary approaches

Question 1: How does a basic emotion differ from simply a discrete emotion?

Basic emotions are a special class of discrete emotions, a subset of emotions that are most elemental; most distinct; most continuous across species, time, and place; and most intimately related to survival-critical functions. Because basic emotions are a subgroup of discrete emotions, they inherit key features shared by all discrete emotions. These include separateness (there are clear boundaries that distinguish one discrete emotion from another), finiteness (the number of discrete emotions is limited), and singularity (the recipe for a discrete emotion cannot be reproduced by blending varying quantities of dimensional ingredients such as valence and arousal).

Theorists differ as to the particular characteristics that are considered necessary and sufficient for affording basic emotion status to a discrete emotion. In my view, these characteristics are: (a) distinctness (primarily in behavioral and physiological characteristics), (b) hard-wiredness (circuitry built into the nervous system), and (c) functionality (provides a generalized solution to a particular survival-relevant challenge or opportunity).

Question 2: What is your list of basic emotions? Are all emotions basic, or just some? If some, how do you distinguish basic from nonbasic emotions? What is the relation of nonbasic to basic emotions?

Only a subset of discrete emotions is basic. Based on my criteria those basic emotions must have qualities of distinctness, hard-wiredness, and functionality; I believe that the best evidence exists for six basic emotions (with associated functions in parentheses): (a) enjoyment (playing), (b) anger (fighting), (c) disgust (rejecting), (d) fear (avoiding), (e) surprise (orienting), and (f) sadness (help seeking). There are three additional emotions that I believe are basic, with well-established functionality, but for which the existing evidence for distinctness and/or hard-wiredness is not as strong: (g) relief/contentment (soothing), (h) interest (exploration), and (i) love (attachment). Although mostly single emotion terms are used in this list of basic emotions, in reality each represents a "family" (Rosch & Lloyd, 1978; Rosch & Mervis, 1975; Russell, 1991) of closely related emotions. Thus, the basic-emotion family of sadness would include emotions such as distress and anguish.

Distinguishing basic emotions from other emotions requires proposing criteria, postulating the evidentiary basis for each criterion, and evaluating the state of the existing evidence. Any discussion of criteria for basic emotions must start with Ekman's (1992) nine criteria. With some aggregation, his list can be reduced into three larger groupings: (a) distinctness (in antecedents, signal, and physiology), (b) continuity (presence in other primate species, same antecedents in all cultures, same signals in all cultures), and (c) structure/function (quick onset,

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brief, unbidden, coherence among responses, automatic appraisal). My three criteria borrow from these larger groupings, including distinctness (but primarily established by evidence of modularity in the nervous system), hard-wiredness (inferred from evidence of continuity across species, development, and place), and functionality (with greater concern for antecedent conditions and less concern for particular structural qualities).

Distinctness

Establishing distinctness requires a basic emotion to have qualities that distinguish it from other emotions (in particular, from other basic emotions). Traditionally, evidence for distinctness has taken the form of differences in behavior (e.g., motor action patterns), expression (e.g., facial and vocal signals), physiology (e.g., autonomic or central nervous system activity), and, if appropriate to the species, language (e.g., emotion words, self-reports of emotional experience). I believe that these approaches remain largely valid, but will argue later (Question 8) that, even when language is available, behavior and physiology should be afforded greater weight.

Alternative approaches to establishing distinctness, which may ultimately prove to be even more useful, make use of neurological patients and stimulation/blocking of particular brain circuits. With these methods, support for distinctness is obtained when particular emotions appear or disappear in particular neurological diseases or when particular brain circuits are stimulated or blocked.

As an example of the utility of using neurological patients for exploring distinctness, we (Olney et al., 2011) have recently been working with a group of patients with amyotrophic lateral sclerosis (a progressive motor neuron disease). Many of these patients manifest pseudobulbar affect (Wilson, 1924), which consists of spontaneous episodes of uncontrolled laughing and crying. These episodes include intense “prototypical” facial expressions of happiness and sadness, coupled with high-magnitude autonomic and respiratory responses consistent with these emotions. Some of these patients laugh, some cry, and some do both. But we have never seen any instances of spontaneous uncontrolled anger, fear, disgust, or surprise, supporting distinctness between the emotions that occur spontaneously and those that do not. A related approach, focusing on emotional deficits, is seen in studies of patients with Huntington’s disease. These patients have been reported to have deficits in the processing and production of disgust but not in other emotions (Gray, Young, Barker, Curtis, & Gibson, 1997; Sprengelmeyer, Young, Calder, & Karnat, 1996; Sprengelmeyer et al., 1997).

Examples of studies using stimulation and blockade methodologies have also been informative. In cats, the elicitation of a particular emotion, anger (so-called “sham rage”), has been associated with acute brainstem transection and amygdala stimulation (Reis & Gunne, 1965; Reis, Miura, Weinbren, & Gunne, 1967). Studies using transcranial magnetic stimulation (George et al., 1996) and selective pharmacological blockade (Lawrence, Calder, McGowan, & Grasby, 2002) show promise for illuminating the brain regions and circuits that elicit and disrupt particular emotions.

Hard-Wiredness

Establishing hard-wiredness requires that the circuitry for a basic emotion is built into the nervous system in at least some primitive form. Learning and experience may shape and enhance the original circuitry, but if an emotion has to be learned de novo, then that emotion is not basic.

When attempting to establish hard-wiredness, researchers have most often sought evidence of continuity across species, development, and cultures. Each of these approaches has value, but also has limits. First, each approach must be accompanied by the caveat that evidence of continuity is being extrapolated from a particular subsample of species, developmental stages, and cultures and, thus, does not establish universality for *all* species, stages, and cultures. Second, judgments as to what constitutes similarity are complicated by ontogenetic and phylogenetic differences among species and developmental stages, and by language differences among cultures. Third, using cross-cultural studies (and even more so for cross-national studies) to establish universality has become particularly problematic. With any demonstration of similarities between disparate cultures, there is an alternative explanation that the cultures, facing similar kinds of problems and possessing similar resources, could have learned the same emotion in the same way. Researchers have traditionally sought to maximize isolation and maximize differences between cultures as a way of minimizing this possibility. However, this approach can never totally eliminate the alternative learning explanation. Moreover, globalization and ecological changes have made cultural isolation essentially nonexistent. Thus, emotional similarities that are found between even the most seemingly disparate cultures no longer have the cachet they once had for establishing hard-wiring.

Functionality

Establishing functionality requires evidence that a basic emotion addresses a particular challenge or opportunity or solves a particular problem that is critical to species survival and thriving. Often this particularity is established by well-reasoned assertion. Thus, anger is said to be the solution for the problem of needing to keep control of that which is ours; a functional explanation that seems reasonable and compelling. The force of these assertions can be strengthened by careful consideration of the evolutionary environments of our ancestors, the likely problems they encountered, and the likely resources they possessed (Tooby & Cosmides, 1990).

In the more empirical realm, functionality is often established by searching for particular antecedent conditions that are associated with particular emotions or that elicit these emotions. A number of studies have sought evidence of cross-cultural consistencies in these antecedent conditions (Boucher, 1983; Matsumoto, Kudoh, Scherer, & Wallbott, 1988; Scherer, Summerfield, & Wallbott, 1983). Another approach has been to examine the consequences of particular emotions. For example, we (Fredrickson & Levenson, 1998; Yuan, McCarthy, Holley, & Levenson, 2010), have demonstrated that efficient reduction of physiological arousal produced by negative emotions is a function of emotions such as enjoyment and contentment (but not of other basic emotions). Similarly, in building their case for embarrassment as a basic emotion, Keltner and Buswell (1997) accumulated extensive evidence that its primary function is appeasement.

Controversies

Major disagreements have arisen in the basic-emotion literature over the methodologies used to collect data and the evidentiary thresholds for meeting each criterion. A classic example can be found in the study of facial expressions associated with different emotions, one of the most extensively studied aspects of emotion in the literatures related to both distinctness and hard-wiredness. In terms of methodology, most studies have had participants identify the emotions depicted in photographs of emotional expressions. But, these studies can all be criticized for using a methodology based on emotion *recognition* and not on emotion *production*. In terms of evidentiary thresholds, almost all of the "classic" studies found agreement across cultures at greater than chance levels for recognizing emotions such as anger, contempt, disgust, fear, happiness, sadness, and surprise (Ekman & Friesen, 1971; Ekman & Heider, 1988; Izard, 1971). Moreover, a newer generation of these studies has argued that cross-cultural agreement also exists for self-conscious emotions such as embarrassment and pride (Keltner, 1995; Tracy & Robins, 2008), and some recent studies have examined production as well (Elfenbein, Beaupre, Levesque, & Hess, 2007; Matsumoto & Willingham, 2006, 2009; Tracy & Matsumoto, 2008). However, in all of these studies, both old and new, the level of agreement varies across cultures and emotions, and perfect agreement has been rare. This begs the question of how much agreement is "enough."

Finally, when multiple criteria are proposed, there can be disagreement over how many must be met: one, some, or all? I have posited three criteria that I believe are essential for affording basic-emotion status: distinctness, hard-wiredness, and functionality. For an emotion to be deemed basic, evidence in support of all three criteria would be necessary and sufficient. However, this is not a case of one size fitting all. For example, evidence of distinctness for one basic emotion might derive from evidence of universality of facial expression, and for another from evidence of unique blocking by transcranial stimulation. Moreover, confidence that an emotion is basic will surely increase to the extent that multiple sources of evidence exist in support of each criterion.

Question 3: Does the existence of a basic emotion depend on the existence of a central organizing mechanism (something like an "affect program") or can a basic emotion be simply a patterned response?

For an emotion to be basic, there needs to be a central organizing mechanism. In my view, this mechanism operates by searching continuously for meaningful patterns in incoming sensory information, recognizing survival-critical situations, and activating the appropriate emotion, which recruits and orchestrates the optimal behavioral and physiological responses. In an earlier formulation (Levenson, 1999), I described this central organizing mechanism as the "core system," recognizing its debt to Tomkins' "affect program" (Tomkins, 1962). In my view:

> the core system has all of the capabilities necessary for processing incoming information continuously and for detecting a small number of prototypical situations that have profound implications for the organism's immediate well-being and long-term survival. Having recognized in the stream of incoming perceptual information the configuration of features that defines one of a small number of prototypical situations, the core system activates an emotion, which is comprised of a set of response tendencies that have been selected by evolution for their high probability of dealing successfully and efficiently with the problems posed by that particular situation. The configural features of the prototypical situation and the exact features of the response package that is recruited differ from species to species (e.g., differences across species in what constitutes a predator and in the acoustic qualities of a fear vocalization), but the basic purpose and operation of the core system is the same (i.e., matching environmental events to prototypes, recruiting and orchestrating the appropriate response). (Levenson, 1999, p. 484)

Thus, my view of a basic emotion's organizing mechanism includes: (a) a very fast, low-level pattern detector on the input side tuned to survival-significant events, and (b) a very fast, low-level mechanism on the output side that efficiently recruits and organizes disparate perceptual, behavioral, and physiological systems to produce a response most likely to provide a successful solution to the challenges or opportunities posed by these events.

Extrapolating from my answer to Question 2, the central organizing mechanism would have to be initially hard-wired in the nervous system in at least a primitive form. However, the control mechanisms that regulate it can be greatly influenced by learning, experience, and, in humans, higher order processes such as goals, values, and social norms. Previously (Levenson, 1999) I described the interplay between the central organizing and control mechanisms as follows:

> At the core of the emotion system is a remarkably durable, simple, and efficient "processor", designed early in evolution to cope effectively with a few very basic, ubiquitous problems (e.g., Ekman, 1992; Lazarus, 1991; Levenson, 1994; Tooby & Cosmides, 1990) in time-tested, highly predictable, and quite automatic (e.g., Zajonc, 1984) ways. Surrounding this core system is a more recently evolved, highly flexible, and much less predictable set of control mechanisms that are designed to influence the actions of the core system. Whereas the core system is largely hard-wired and not capable of major modification in response to experience, the control mechanisms are exquisitely sensitive to learning, fine-tuning their operating parameters across the course of life […] The control system acts on the "input" to the core system by altering the conditions that set the core system into action (e.g., Lazarus, 1991; Scherer, 1984; Smith & Ellsworth, 1985), and it acts on the "output" of the core system by intercepting tendencies to respond to prototypic situations in characteristic, stereotypical ways and modulating the translation between response tendencies and resultant behavior (e.g., Ekman & Friesen, 1969; Hochschild, 1979). (Levenson, 1999, pp. 483–484)

In my view, the central organizing mechanism retains the capacity to override these control mechanisms and other higher order cognitive processes under conditions where challenges and opportunities appear clearly, suddenly, and intensely. One important implication of this for studies of basic emotions is that their organizing effects will be seen most clearly when elicitors are focused, powerful, sudden, and closely match prototypical antecedent conditions (Levenson, Soto, & Pole, 2007). In social science experiments, this is often not the case. Rather, in these studies, emotional stimuli are typically mild, gradual in onset, diffuse, and do not closely match prototypes. Under these latter conditions, the observed response is likely to be a complex mixture of responses associated with the basic emotion combined with the responses associated with emotion regulatory (Gross & Levenson, 1997) and other higher order processes.

Question 4: In everyday discourse, emotions cause certain behaviors (fear makes us flee, makes our heart race, makes us think irrationally, and so on). In your theory, does a basic emotion have such causal powers? Which powers?

Basic emotions certainly have the power to influence behaviors, thoughts, and many other fundamental processes. However, rather than use the term "cause," I view this influence as more probabilistic. Thus, in an earlier theoretical formulation (Levenson, 1994a), I stated that emotions "alter attention, shift certain behaviors upward in response hierarchies, and activate relevant associative networks in memory" (p. 124). I think the terms "alter," "shift," and "activate" in this statement better capture what emotions do than does the term "cause." In that earlier formulation I gave some examples of this process:

> Emotions have the capacity to activate certain behaviors, which might normally exist at the bottom of behavioral hierarchies. Thus, under the proper conditions, anger can drive the pacifist to fight; sadness can make the strong weep; and fear can cause the brave to cower. In this regard, emotion has the unique capacity to set aside, in a moment, a lifetime of individualized learning, refinement, culture, and style, revealing the common denominator of human response. (Levenson, 1994a, p. 124)

Combining this notion with my views about the conditions under which basic emotions have the capacity to override regulatory and higher processes (Question 3), I believe that the influence of basic emotions on behaviors and thoughts becomes most deterministic under those conditions in which antecedent conditions closely match prototypical elicitors, eliciting conditions onset most suddenly, and emotions are most intense (Levenson et al., 2007). When these conditions are *not* met, the plasticity and flexibility of the emotion system becomes more ascendant.

Question 5: In what sense are basic emotions basic? Specifically, please touch on the questions about what makes a basic emotion basic: must the emotion be evolutionarily shaped? Biologically prewired? Psychologically primitive? A building block of other emotions? All of the above?

In my view, a basic emotion has to be evolutionarily shaped *and* biologically prewired. Basic emotions arise from the need for solutions to a small set of prototypical challenges, problems, and opportunities that have profound implications for species survival and thriving. In mammalian species, these include such things as bonding with others, handling threats, dealing with loss, defending what is ours, avoiding noxious substances, and soothing self and others. The ubiquity and importance of these challenges, problems, and opportunities would have created enormous selection pressures favoring generalized solutions for each—solutions that have the highest likelihood of producing beneficial outcomes for the individual and for the group most of the time. Thus, basic emotions are the time-tested solutions to these timeless problems. Because of their importance, having each individual learn each solution de novo would be inefficient and uncertain. For this reason, these well-honed solutions are best situated in the original hard-wiring of the nervous system.

Beyond this, basic emotions differ in many ways. Some, like fear, appear earlier in phylogeny and ontogeny, have relatively simple neural circuitry, and thus could be said to be psychologically primitive. However, this seems more relative than absolute. For this reason, I would be reluctant to stipulate psychological primitiveness as a requirement for basic-emotion status.

Similarly, basic emotions may well serve as building blocks for other more complex emotions and for more complex emotion-related states. However, this is more an example of nature sometimes reusing its good ideas rather than a requirement. Moreover, I do not endorse the view that complex emotions are all composed from a single palette comprised by the basic emotions. To reduce emotions such as pride, shame, embarrassment, awe, or guilt into X units of one basic emotion and Y units of another makes little sense. Although there may be some happiness that goes into pride and some sadness that goes into shame, each also has emergent qualities that cannot be explained in terms of the small set of emotions I consider to be basic.

Question 6: How are basic emotions differentiated one from another?

Basic emotions may differ from each other in numerous ways, but the essential differentiation begins with function. If you accept that basic emotions evolved to help to solve species-specific problems (Tooby & Cosmides, 1990) in highly efficient, generalized ways (Levenson, 1999) then, for problems with a hard-wired solution, that solution should be embodied in a single discrete emotion. From this functionalistic first principle, other differentiating features arise. Thus, in social species there are great advantages when an individual is in the throes of a basic emotion for that emotional state to be communicated to conspecifics. The origins of the morphology of these signals has long been a topic of great interest (Darwin, 1872). In my view, most of these signals derive from the behavioral and physiological adjustments the basic emotion orchestrates in fine-tuning the organism to best be able to deal with the problem at hand. Depending on the response system, the specific indicator, and the basic emotions being considered, the differentiation of signals by emotion can range from partial to complete.

Facial expressions are informative in this regard. Functionalist views typically begin with speculation as to the purpose that might have originally been served by a particular muscle contraction or set of contractions (for a supportive analysis, see Susskind & Anderson, 2008). Thus, raising the eyelid (AU5 in the Facial Action Coding System; Ekman & Friesen, 1978) could serve to increase the amount of light entering the eye, improving visual acuity. This kind of fine-tuning of the visual system would be useful in dealing with a number of emotion-eliciting situations. Following this logic further, it is not surprising to find that AU5 appears in the prototypical facial expressions (Ekman & Friesen, 1975) for a number of basic emotions, including surprise, fear, and anger. In all three emotions, the utility of an adjustment in the facial muscles that increases visual acuity is apparent. However, AU5 is not *sufficient* for identifying any one particular basic emotion. Rather, it provides a useful clue for distinguishing one subset of basic emotions (fear, anger, surprise) from another subset of basic emotions that do not include this action (e.g., enjoyment, sadness, and disgust). Another action unit, AU9, which produces visible wrinkling of skin along the sides of the nose, is thought to serve the function of closing off the airways to noxious odors. Unlike AU5, which is found in several basic emotions, AU9 is only found in one, appearing in disgust but not in other basic emotions such as enjoyment, anger, fear, sadness, or surprise.

Autonomic nervous system adjustments also assume an important position in most functional views of emotion, acting to produce the optimal bodily milieu for supporting the behavioral adaptations associated with basic emotions (Levenson, 1988, 1992, 1994b). In addition to producing measurable changes in bodily functions (e.g., alterations in heart rate, skin conductance, etc.), many autonomic nervous system adjustments produce appearance changes that are highly visible (Levenson, 2003) and have signal value that rivals that of changes in facial expression (e.g., changes in coloration, piloerection). As with particular facial actions, a particular autonomic change may distinguish among subsets of basic emotions rather than being unique to a particular emotion. Thus, for example, we and others have found that marked increases in heart rate distinguish one subset of basic emotions (anger, fear, sadness) from another subset that shows little change in heart rate (enjoyment, surprise), and from disgust, which shows heart rate slowing (Ekman, Levenson, & Friesen, 1983; Levenson, 1992).

Those who believe that facial expressions and patterns of autonomic nervous system activity are defining features of basic emotions do not typically think that basic emotions are differentiated by a single unique facial action or a single unique physiological change, but rather that they are distinguished by unique *configurations* of multiple facial actions or of multiple physiological responses. As a result, there are sizeable literatures that have searched for these configurations, and numerous spirited debates about the quality of existing evidence in support of the specificity of facial and autonomic configurations (Levenson, 1992; Zajonc & McIntosh, 1992).

Question 7: If your list of basic emotions is a set of English terms, how do you respond to the claim that some languages lack equivalent terms for those emotions but include emotion terms that differ in meaning from English terms? What is the relation between your basic emotions and the everyday folk language people use to talk about their emotions?

In my view, the ways that we think about, label, and talk about our emotions are socially constructed; they are largely determined by learning, social influence, and culture (Levenson et al., 2007). Although partially grounded in actual emotional phenomena, emotion language is highly influenced by customs, mores, traditions, self-presentation biases, and cultural values. Emotion language may provide important clues about underlying emotional phenomena, but it cannot be considered definitive in adjudicating basic-emotion status according to my three criteria of discreteness, hard-wiredness, and functionality. Thus, a particular culture may not have a term for "sadness." However, this does not mean that members of that culture do not possess the neural circuitry for a distinct sadness response that mobilizes resources for dealing with loss. Similarly, a culture may have a term for an emotion unlike that found in any other culture. The existence of that term does not mean that members of that culture possess discrete, hard-wired, functional circuitry for that emotion.

Emotion language may not be definitive in affording basic-emotion status, but it is still enormously important. Recent theoretical and empirical work has explored the ways that cultures differ in their values and beliefs about what emotions one *should* have (Tsai, Knutson, & Fung, 2006), extending earlier work on cultural feeling rules (Hochschild, 1979) and display rules (Ekman & Friesen, 1969; Friesen, 1972). Nonetheless, I believe these cultural values and beliefs have greater influence on the ways that people talk about, think about, and label their emotional experiences than on the more behavioral and physiological aspects of emotion (Levenson, Ekman, Heider, & Friesen, 1992; Levenson et al., 2007; Soto, Levenson, & Ebling, 2005).

Emotion language can also shed light on issues of fundamental importance to emotion theory. A primary example can be found in the metaphors we use to describe our emotional experiences (e.g., heat and pressure metaphors associated with anger). These metaphors appear to be based on the actual physiological changes that occur during those emotional states (Lakoff, 1987, 1993; Levenson, 2003; Marchitelli & Levenson, 1992). I have endorsed the neo-Jamesian view that our subjective emotional experience is largely constructed from the interoceptive and proprioceptive information that becomes available when emotions (and particularly basic emotions) produce changes in autonomic and somatic nervous system activity (Levenson, 1999). For most people these physical sensations are not very precise (Pennebaker, 1982), but they are consistent enough to produce broad cross-cultural agreement in surveys of the physical sensations that are associated with particular emotions (Wallbott & Scherer, 1988). Recently, we developed a laboratory paradigm for assessing how closely subjective emotional experience tracks underlying physiological and behavioral activity, finding this tracking is quite close during emotional episodes (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005). Moreover, the tracking between subjective experience and physiology is particularly close in those who have received extensive training in attending to and monitoring their visceral activity (Sze, Gyurak, Yuan, & Levenson, 2010).

Question 8: What are the minimal cognitive prerequisites for the occurrence of a basic emotion?

This question recalls the lively exchanges between Zajonc and Lazarus over the issue of whether cognition was necessary for emotion (Lazarus, 1981, 1984; Zajonc, 1980, 1984). In the end, this debate essentially came down to how "cognition" was defined. If cognition was defined as "anything the brain does," then Lazarus' position that all emotion requires cognition held sway. If cognition was defined as a more lengthy, considered process of weighing possibilities, considering alternatives, and planning responses, then Zajonc's position that emotion could occur without cognition won out. Today, this argument would still largely resolve into a question of how you defined cognition and, to an extent, how you defined emotion. For example, reflexes such as the startle response are known to be mediated at the level of the spinal cord (Davis, Gendelman, Tischler, & Gendelman, 1982) and thus, it would be difficult to make the case for the involvement of cognition. However, many would argue that the startle reflex is not an emotion (Ekman, Friesen, & Simons, 1985).

In the 25 years since the Lazarus–Zajonc debate, there has been a remarkable explosion of knowledge about the neural circuitry of emotion derived from affective neuroscience. This work has deeply increased our understanding of the automatic, minimally "cognitive" level of processing that Zajonc championed. We now know that there is very early, low-level processing of incoming sensory information for its emotional relevance in brain centers such as the amygdala, that this processing is fast and automatic, that it can occur absent of conscious awareness, and that it has the capacity to influence subsequent behaviors profoundly (Adolphs, 1999; LeDoux, 2000; Rosen & Levenson, 2009).

Thus, the cognitive prerequisites for the occurrence of a basic emotion are "minimal." Primitive, phylogenetically ancient brain centers like the amygdala are constantly assessing incoming sensory information for patterns of input that are associated with species-specific challenges and opportunities. When such a pattern is detected, it is matched to one of a limited set of basic emotions, each of which has been shaped by evolution to organize behavior and physiology in ways that provide a generalized response that is most likely to deal successfully with the eliciting situation. This all occurs rapidly and does not require any conscious awareness or higher order cognitive processing (e.g., planning, deliberation, measured consideration of response alternatives). The brain is, of course, highly involved in all of this, but the circuitry is quite ancient. Whether this is considered "cognition" or not is a question of definition. But, I believe this level of emotion processing is quite consistent with what Zajonc characterized many years ago as requiring no prior cognition.

Having said that, it must be noted that once this rapid first level of processing occurs, there is usually a "secondary response" in humans in which the original elicitor, the activated response, the personal and social consequences of the activated response, and myriad other factors (social learning, cultural beliefs, values, past experiences, etc.) become involved. These factors can produce a secondary emotional response, which can be more of the same basic emotion, a different basic emotion, a more complex emotion (e.g., a "self-conscious" emotion such as embarrassment, shame, pride, and guilt), or some combination of emotions. I believe this secondary response is clearly "cognitive" in the ways that Lazarus imagined.

Recently, we have been able to show in neurological patients instances in which the initial, simple emotional response remains intact but the more complex secondary emotional response is virtually eliminated (Sturm, Ascher, Miller, & Levenson, 2008; Sturm, Rosen, Allison, Miller, & Levenson, 2006). This evidence for dissociation implies that the neural circuitry for the two kinds of responses is in fact different.

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