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Core Affect, Prototypical Emotional Episodes, and Other Things Called *Emotion:* Dissecting the Elephant

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What is the structure of emotion? Emotion is too broad a class of events to be a single scientific category, and no one structure suffices. As an illustration, *core affect* is distinguished from *prototypical emotional episode*. *Core affect* refers to consciously accessible elemental processes of pleasure and activation, has many causes, and is always present. Its structure involves two bipolar dimensions. *Prototypical emotional episode* refers to a complex process that unfolds over time, involves causally connected subevents (antecedent; appraisal; physiological, affective, and cognitive changes; behavioral response; self-categorization), has one perceived cause, and is rare. Its structure involves categories (anger, fear, shame, jealousy, etc.) vertically organized as a fuzzy hierarchy and horizontally organized as part of a circumplex.

> The word 'emotion' is used to designate at least three or four different kinds of things. (Ryle, 1949, p. 81)

From the beginning of 1991 to the end of 1997, *Journal of Personality and Social Psychology* published 359 articles in which emotion was among the variables assessed. This was approximately 29% of its articles. The topic of this Special Section, the structure of emotion, concerns an essential first step in any scientific treatment of emotion: its description and assessment. Just as the Linnaean taxonomy of species was needed in biology or the periodic chart of elements needed in chemistry, a consensual structure of emotion is needed in psychology. All 359 articles presupposed some structure of emotion, although often implicitly. Unfortunately, there is no consensus on what that structure should be. Indeed, there is every appearance of disagreement: Some researchers use categories, some dimensions; some use bipolar concepts, some unipolar ones; and some presuppose simple structure, some a circumplex, and some a hierarchy.

The key culprit in this mess is the concept of emotion, or *affect*, as it is now sometimes called. Emotion is too broad a class of events to be a single scientific category. As psychologists use the term, it includes the euphoria of winning an Olympic gold medal, a brief startle at an unexpected noise, unrelenting profound grief, the fleeting pleasant sensations from a warm breeze, cardiovascular changes in response to viewing a film, the stalking and murder of an innocent victim, lifelong love of an offspring, feeling chipper for no known reason, and interest in a news bulletin. The boundaries to the domain of emotion are so blurry that it sometimes seems that everything is an emotion. The experts do not agree on what is an emotion and what is not. To be sure, all the different sorts of happenings included within this grab-bag term are important, some vitally so, but it is becoming increasingly clear that not all of them can be accounted for in the same way. No one structure of description and assessment can do justice to this heterogeneous class of events without differentiating one type of event from another.

To illustrate, we distinguish *prototypical emotional episodes* from *core affect*. We are prescriptively defining both terms and therefore do not mean to suggest that our definitions coincide with anyone else's use of these words—although similar distinctions are increasingly appearing (Frijda, 1993; Watson & Clark, 1997). We also do not suggest that these two categories exhaust the domain of emotion.[1] Rather, these two underscore how qualitatively different kinds of events all fall under the term *emotion*. These two are also interesting because considerable research is available on the structure of core affect, whereas we know of no research that has examined actual prototypical emotional episodes

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[1] Far from it. The two concepts, prototypical emotional episodes and core affect, illustrate the diversity of events that fall within the class of emotions. For example, this article is limited to temporary events and slices in time. We omit temperament, attitudes, sentiments, emotional dispositions of any kind, prolonged mood states, psychiatric conditions, simple evaluative responses, perception of emotion in others, perception of emotion-eliciting qualities of events, and even emotional episodes that are not prototypical. Even love and hate, prototypical exemplars of emotion, are not considered here in their typical meaning of long-term emotional conditions, as in lifelong love of an offspring.

when addressing the question of their structure, even though prototypical emotional episodes are what much thinking and writing on emotion are about.

We use the term *prototypical emotional episode* to refer to what most people consider the clearest cases of emotion. Fleeing a bear out of terror, fighting someone in rage, and kissing another enraptured in love are intense examples. Milder examples also exist as in helping someone out of pity or avoiding a stranger out of apprehension. A prototypical emotional episode is a complex set of interrelated subevents concerned with a specific object. The object is the person, condition, event, or thing (real or imagined; past, present, or future) that the emotional episode is about (Solomon, 1976)—one is afraid *of*, is angry *with*, is in love *with*, or has pity *for* something. Prototypical emotional episodes necessarily include all of the following: core affect (to be defined shortly); overt behavior of the right sort (flight with fear, fight with anger, etc.) in relation to the object; attention toward, appraisal of, and attributions to that object; the experience of oneself as having a specific emotion; and, of course, all the neural, chemical, and other bodily events underlying these psychological happenings. Even fleeing a bear involves a sequence of goal-directed behaviors, and therefore prototypical emotional episodes involve plans, although often hastily or ill conceived. Because they are directed at an object, prototypical emotional episodes involve cognitive processes and structures. Much recent work has outlined the cognitive appraisal processes (Frijda, 1986; Roseman, Spindel, & Jose, 1990; Scherer, 1984; Smith & Ellsworth, 1985), attributional processes (Wiener, 1985), and cognitive structures (Ortony, Clore, & Collins, 1988) involved. As episodes, each has a beginning and an end and endures a specific amount of time (measured in minutes). Prototypical emotional episodes are similar to what have been called full-blown emotions, blue-ribbon emotions, or emotion–cognition complexes. In this full-blown prototypical form with all elements present, they are quite rare. (Nonprototypical cases, with one or more element missing or altered, are more common.)

We use the term *core affect* to refer to the most elementary consciously accessible affective feelings (and their neurophysiological counterparts) that need not be directed at anything. Examples include a sense of pleasure or displeasure, tension or relaxation, and depression or elation. Core affect ebbs and flows over the course of time. Although core affect is not necessarily consciously directed at anything—it can be free-floating as in moods—it can become directed, as when it is part of a prototypical emotional episode. Even when free-floating, core affect is still caused; indeed, it is subject to many causal forces from specific events to the weather to diurnal cycles (Thayer, 1989; Watson, Wiese, Vaidya, & Tellegen, 1999), some of which are beyond the human ability to detect.

Core affective feelings vary in intensity, and a person is always in some state of core affect, even if neutral (Diener & Iran-Nejad, 1986; Diener, Sandvik, & Pavot, 1991). When mild, core affect can fade into the background of consciousness, but it can be overpoweringly salient when intense. (An analogy might be perceived temperature.) Core affect can be seen in its purest form waking up feeling chipper (or tense or depressed or relaxed) for no apparent reason. It can also be seen in many events that are not prototypical emotional episodes, such as feeling miserable from a low-grade infection, feeling joy or sadness from listening to sublime music, feeling tension at the end of a stressful day, feeling excitement while reading a taut novel, and feeling serenity on a lazy summer day spent at the shore. And, of course, core affect can be seen as the elemental feelings included within prototypical emotional episodes (such as the activated displeasure within the episodes of fear, grief, anger, and pity described above). Core affect is similar to what Thayer (1986) called *activation*, what Watson and Tellegen (1985) called *affect*, and what others have called *feeling* or *mood*. (We define *mood* as prolonged core affect without an object or with a quasi-object; see Russell, 1996.)

Even though related, *core affect* and *prototypical emotional episodes* are conceptually separable. Put differently, we believe that emotional episodes must be broken down into their fundamental constituents, and we postulate core affect as one of those constituents. Ever-present core affect occurs more often outside than inside the relatively rare prototypical emotional episode. Core affect and prototypical emotional episodes are thus related and partly overlapping but far from identical. (We believe that core affect is at the heart of any emotional episode, prototypical or not, which typically begins as an abrupt change in core affect in response to some event but develops further once cognitive structures are invoked, an object is identified, and behavioral plans are quickly formed and enacted. But that's another story; see Russell, 1996.)

We would not want our proposed distinction confused with other possible distinctions. For example, both core affect and prototypical emotional episodes vary in intensity and in duration. Emotion words cannot be divided into those that denote core affect and those that denote prototypical emotional episodes. Although some words more typically refer to one than the other, most emotion words can refer to either. Consider the word *happy*. On receiving a gift, Sally feels happy, smiles, and hugs the person who gave her the gift. Another time, Sally feels happy for no known reason. The first case would be a prototypical emotional episode, the second not. Both involve core affect.

In this article, we do not offer theories of either core affect or prototypical emotional episodes. Our topic is the more preliminary step of definition and description. Although our proposed distinction is speculative and our use of terms unusual, we argue that this distinction clarifies issues in the structure of emotion and has methodological implications. Once a distinction between these two is drawn, the door is open to other distinctions within the broad realm of emotion, and there is likely to be much more agreement on structure than is apparent from recurring debates.

Structure of Prototypical Emotional Episodes

Theorizing about emotion centers on prototypical emotional episodes, which are almost always thought of as discrete categories. The categories (fear, anger, grief, love, hate, and the like) almost always stem from the everyday folk categorization captured by words found in any dictionary of the English language. This reliance on everyday categorization can be seen in the use of human raters and verbal self-reports and in the implicit categorization made by the researcher. Indeed, these categories seem so natural that it is sometimes forgotten that they are semantic categories rather than facts of nature. We therefore begin with a look at these categories.

First, categories in English are similar—but not identical—to categories found in other languages (Russell, 1991; Wierzbicka,

1992). For instance, the number of categories varies from language to language. In English, there are between 500 and 2,000 categories (Averill, 1975; Wallace & Carson, 1973); in Ifaluk, there are about 50 categories (Lutz, 1982); in Chewong, about 7 (Howell, 1989).

Second, membership in each emotion category is a matter of degree rather than all or none, and the border between categories is blurry. Fleeing the bear is an excellent example of fear, and it is the sort of example that comes to mind when fear is analyzed. But other, equally real events exist that are less clear examples: having a nightmare, hesitating before taking on a difficult assignment, riding a roller coaster, and watching a horror film. The best examples of the category are the prototypical emotional episodes, but the category includes less typical events and fades off into borderline cases and noncases. Events within each category appear to share a family resemblance rather than a set of common features.

Third, each category consists of its own script, the set of temporally ordered and causally related subevents that together make up the entire episode (Abelson, 1981; Averill, 1980; Fehr & Russell, 1984; Fischer, 1991; Tomkins, 1979). In other words, anger, fear, and the like are complex processes rather than simple responses (Frijda, 1986; Lazarus, 1991; Scherer, 1984). Describing and assessing the constituent subevents is thus one aspect of the structure of each category of emotion.

Because prototypical emotional episodes are complex packages of components, it is possible to organize them in different ways. Each component of the episode provides a separate basis for a taxonomic structure. Rather than one structure of emotion, there are various (complementary) possibilities. We describe three of these: a basic-categories structure, a dimensional structure, and a hierarchical structure.

Basic Categories

The principal attempt to structure prototypical emotional episodes has been to seek a set of mutually exclusive, discrete "basic" categories. (By mutually exclusive, we mean that even though a person might undergo two emotions simultaneously, each emotion belongs in one and only one of the basic categories.) And, indeed, great clarity would be achieved if all emotional episodes could be reduced to some small number of such basic categories. Because emotional episodes are complex, there are various ways to divide them into basic categories. Here are seven possibilities.

First, classification could be based on the facial expression involved (if facial expressions are in fact involved). Ekman (1984) proposed that all emotions produce facial expressions (unless masked) and that the natural boundaries between types of emotion could be determined by differences in facial expression. He subsequently abandoned the idea (Ekman, 1993), apparently for two reasons: (a) the existence of emotions for which no facial signal exists (he listed awe, guilt, and shame as potentially lacking a facial signal) and (b) the existence of different emotions that share the same signal (different categories of positive emotions all share the smile). Second, classification could be based on the pattern of autonomic nervous system activity involved (Ekman, Levenson, & Friesen, 1983). Research has yet to establish patterns associated with specific emotions (Cacioppo, Klein, Berntson, & Hatfield, 1993; Zajonc & McIntosh, 1992; but see Davidson & Ekman, 1994). Third, classification could be based on the dimensions of cognitive appraisal through which the object of the emotion is interpreted. Roseman et al. (1990), Frijda (1986), Scherer (1984), and Smith and Ellsworth (1985) have developed such systems, and the convergence across authors is great. Fourth, classification could be based on the cognitive structure presupposed. Ortony et al. (1988) proposed one such system. Fifth, classification could be based on the behavioral response or action tendency involved (Frijda, 1986; Plutchik, 1980). Sixth, classification could be based on the person's own categorization of the episode. This is the rationale behind structures derived from factor analyses of self-reported emotion (Izard, 1977; McNair & Lorr, 1964). And seventh, classification could be based on the brain structures and neurotransmitters that underlie emotional episodes (Panksepp, 1982).

Unfortunately, these seven lines of research do not seem to be converging on the same set of basic categories (Ortony & Turner, 1990) as seen, for example, simply in the final number of categories identified. Whereas Ekman et al. (1983) identified 4 basic emotions from patterns of autonomic nervous system activity, Ekman and Friesen (1986) identified 7 basic emotions from facial expression, and Ortony et al. identified 22 basic emotions from cognitive structures involved.

A Dimensional Structure, Including a Circumplex

Prototypical emotional episodes vary along certain dimensions, such as intensity, degree of pleasure, or degree of activation. Not every case of, for example, fear has an identical amount of (dis) pleasure and activation. (Roller coaster rides are not as unpleasant as being chased by a bear.) Rather, each specific case (e.g., Alice's fear on spotting the charging bear in the woods last Tuesday) involves a specific degree of pleasure and activation.

Factor analyses of self-reported emotions and multidimensional scaling of words for emotion, facial expressions of emotion, and vocal expressions of emotion often yield two broad dimensions interpretable as pleasure and arousal. Emotion categories do not cluster at the axes, and thus the structure of emotion has been said to be a circumplex. Nevertheless, although we are among those who emphasize such findings, we now believe this dimensional structure represents and is limited to the core affect involved. Prototypical emotional episodes fall into only certain regions of the circumplex (as shown in Figure 1). More important, qualitatively different events can appear as if the same when only this dimensional structure is considered: Examples of fear, anger, embarrassment, and disgust could share identical core affect and therefore fall in identical places in the circumplex structure. Thus, the pleasure and arousal dimensions and the circumplex represent one component of each prototypical emotional episode but not other components, and these other components are thus what would, in this example, differentiate among fear, anger, embarrassment, and disgust. (Assessment devices based on the dimensional–circumplex approach capture core affect but miss the other components.)

Hierarchy

A hierarchy has long been used to capture another property of emotion categories: Some are subtypes of others (Fehr & Russell,

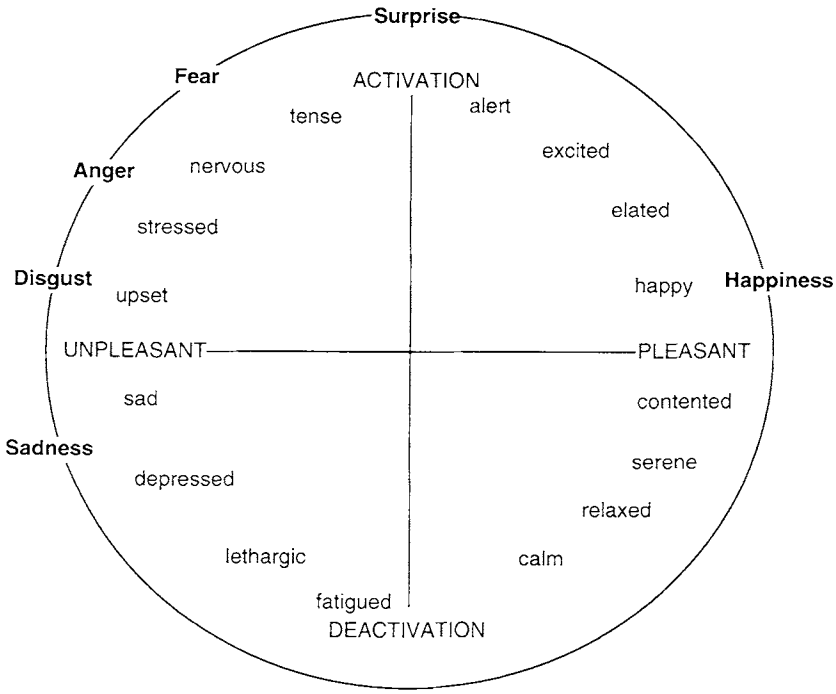

Figure 1. The inner circle shows a schematic map of core affect. The outer circle shows where several prototypical emotional episodes typically fall. Modified from Feldman Barrett and Russell (1998). Copyright 1998 by the American Psychological Association.

1984; Storm & Storm, 1987). Typically, the superordinate category emotion is subdivided into fear, anger, and so on. These middle-level categories, in turn, are further subdivided, such as fear into terror, anxiety, panic, and so on; anger into annoyance, fury, indignation, and so on.

There are several problems with this approach. Because the hierarchy consists of discrete categories, it poorly represents such continua as pleasure and activation. Thus, a hierarchy complements rather than competes with a dimensional structure. More important, emotions do not form the usual strict class-inclusion hierarchy. (The following is an example of a strict hierarchy: A square is a type of quadrilateral, which is a type of plane geometric figure.) Instead, the emotion hierarchy is fuzzy (Russell & Fehr, 1994). Subordinate categories are not proper subsets of the next higher level (not every case of indignation is a case of anger or of emotion). Categories at one level are not mutually exclusive. Indeed, the levels themselves are fuzzy: The emotion hierarchy cannot be neatly divided into quantum levels (superordinate, middle, and subordinate), but, rather, categories vary quantitatively in degree of breadth.

A Proposal and Prognosis for Further Development

The search for a small number of basic emotions will continue, especially based on advances in neuroscience. However, for many purposes, we suggest a structure that does not reduce emotions to some small number of basic ones. Our proposal is to combine the dimensional structure with a fuzzy hierarchy. The fuzzy hierarchy is a vertical organization, capturing differences in breadth of each category. Middle-level categories can also be organized horizontally by the circumplex and the dimensions it contains. The combined fuzzy hierarchy–circumplex structure is an explicit representation of the structure implicit in human judgments about emotion.

One neglected question is just how suited any discrete category system ultimately is for scientific work on emotion. Over a century ago, James (1884) noted the variety of emotion categories and despaired of further progress in a purely descriptive taxonomy. He proposed instead a focus on causal mechanisms, and we echo his advice. Not all of the properties of our current category system per se are desirable from a scientific point of view. Vague boundaries, an unspecified number of overlapping categories, and ill-defined concepts limit the precision and rigor aimed at in science. To be sure, the events themselves are extremely important, and we need further progress in understanding how to describe and assess them in a scientifically useful manner. We offer the circumplex–fuzzy hierarchy as a useful tool for now but hope to move beyond it.

One needed step in moving beyond is to consider each of the subevents that together make up a prototypical emotional episode (antecedent, appraisal, attribution, core affect, cognitive processing, behavior, and all the neural and chemical processes involved). In this article, we consider core affect.

Structure of Core Affect

Core affective feelings and their neurophysiological substrate are two sides of the same coin. Here we focus on the subjective feeling side, at the level of how people experience core affect and report that experience. We believe that psychology must include these consciously accessible feelings, and we believe that a heuristic descriptive structure results from this level of analysis. In-

deed, we are optimistic that a consensus on the structure of core affect so conceptualized is at hand.

In this section, we offer our candidate for this consensual structure. We propose that core affect at any slice in time can be described by two independent dimensions, degree of pleasantness and degree of activation. The Cartesian space formed from these two dimensions is shown in the inner region of Figure 1. The structure of core affect is much simpler than the structure of prototypical emotional episodes already discussed. We argue that this simple system can summarize the data on current affect and integrate various proposed structures.

Pleasure, at the level of subjective experience, summarizes how well one is doing. Despite other disagreements, writers from the pre-Socratics through later philosophers and the introspectionists (such as Wundt, Stumpf, and Titchener; see Reisenzein, 1992; Reisenzein & Schonpflug, 1992) to Ortony et al. (1988) have described the role of pleasure and displeasure in human affairs. All known human languages have words to communicate pleasure and displeasure (Wierzbicka, 1992), and the pleasure–displeasure dimension appears pancultural in emotion lexicons (Russell, 1991). Pleasure is once again playing a significant theoretical role in psychology (Cabanac, 1995; Kahneman, Diener, & Schwarz, in press; Shizgal & Conover, 1996). Different writers approach these feelings from different conceptual stances. Hence, what we call *pleasure–displeasure* has been named differently—*valence, hedonic tone, utility, good–bad mood, pleasure–pain, approach–avoidance, rewarding–punishing, appetitive–aversive, positive–negative*—but the similarity is clear.

Activation, at the level of subjective experience, refers to a sense of mobilization or energy. A person senses being somewhere on a continuum ranging from, at the low end, sleep through drowsiness, relaxation, alertness, activation, hyperactivation, and finally, at the opposite end, frenetic excitement. Subjective feelings of activation are not illusions, but a summary of one's physiological state. Still, the relation between the relatively simple subjective experience of activation and its actual complex neurophysiological substrate is poorly understood; we return to this topic shortly. Activation rises and falls in a diurnal rhythm and varies with intake of stimulant and depressant drugs, with one's own physical activity, and with the events of the day. Indeed, activation is related to everything from the current stimulus to personality to neurochemistry (Thayer, 1989, 1996). The activation dimension—again thought of from very different conceptual stances—has been prominent in theories of emotion throughout this century (Berlyne, 1960; Cannon, 1927; Duffy, 1957; Frijda, 1986; Hebb, 1955; Lindsley, 1951; Mandler, 1984; Pribram & McGuiness, 1975; Schachter & Singer, 1962; Thayer, 1989; Zillmann, 1983) and can be seen in Darwin's (1872/1965) third principle of emotional expression. Accordingly, what we call *activation* has been named differently—*arousal, energy, tension, activity*—but, again, the similarity is clear.

All possible combinations of these two independent pleasure and activation dimensions occur. The resulting space thus includes many states (such as fatigue, sleepiness, and placidity) that are not emotions, but it provides a descriptive map of core affect at any point in time. To illustrate, Figure 2 shows the frequency distribution from a sample of 535 persons who described their affective feelings at a moment in time arbitrarily selected from their waking day.

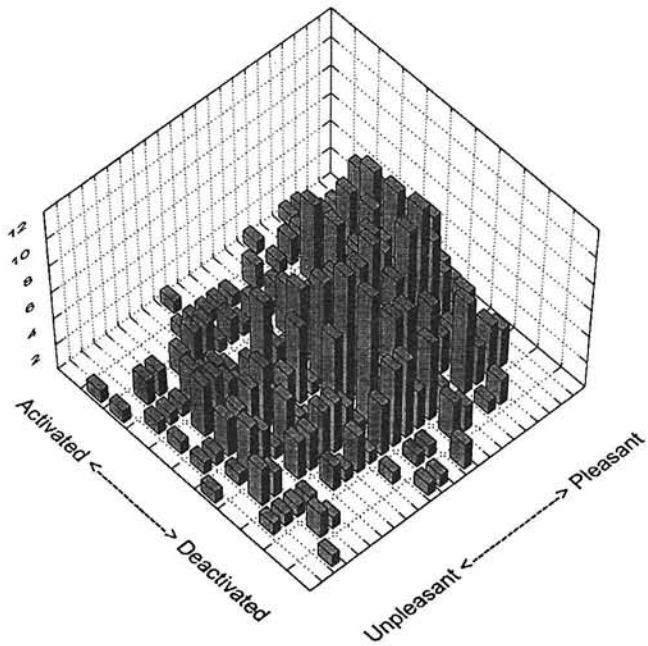

Figure 2. The bivariate frequency (altitude dimension) distribution of core affect for 535 individuals at an arbitrarily chosen remembered moment. Data are from Yik (1998).

At any point in time, core affect is a blend of pleasure and activation. The two components combine in an integral fashion, so that, subjectively, a person has one feeling rather than, for example, unpleasant and, separately, deactivated. The center of the space is an adaptation level, the subjective neutral point. Intensity of a specific named affective state is the distance from the center to a point representing that state (Reisenzein, 1994). Figure 1 names specific blends (as points in the space or, better, regions), but these names require a note of caution. We use the emotion names merely as guideposts and do not mean to imply that the names denote only pleasure and activation. Without these names, core affect is difficult to describe—as would be other primitive, irreducible qualities.

Six interrelated issues present themselves as controversial about Figure 1: the question of alternative structures (what about the competition?), rotation of the dimensions (should they be 45° away?), the number of dimensions (is it really two?), their bipolarity (have not positive and negative affect been found to be independent?), the circumplex form (what about simple structure?), and the relationship of affective feeling to the underlying neurophysiological state (does Figure 1 mix apples and oranges?). We address each controversy in turn.

Integration of Alternative Structures

There now exist a number of two-dimensional structures of core affect, each given a different interpretation. Figure 3 shows four available structures (rotated and reoriented to emphasize their similarity to our structure in Figure 1). From the names used in each structure, one might think that each describes different phenomena. Yet, their creators assumed that the various structures

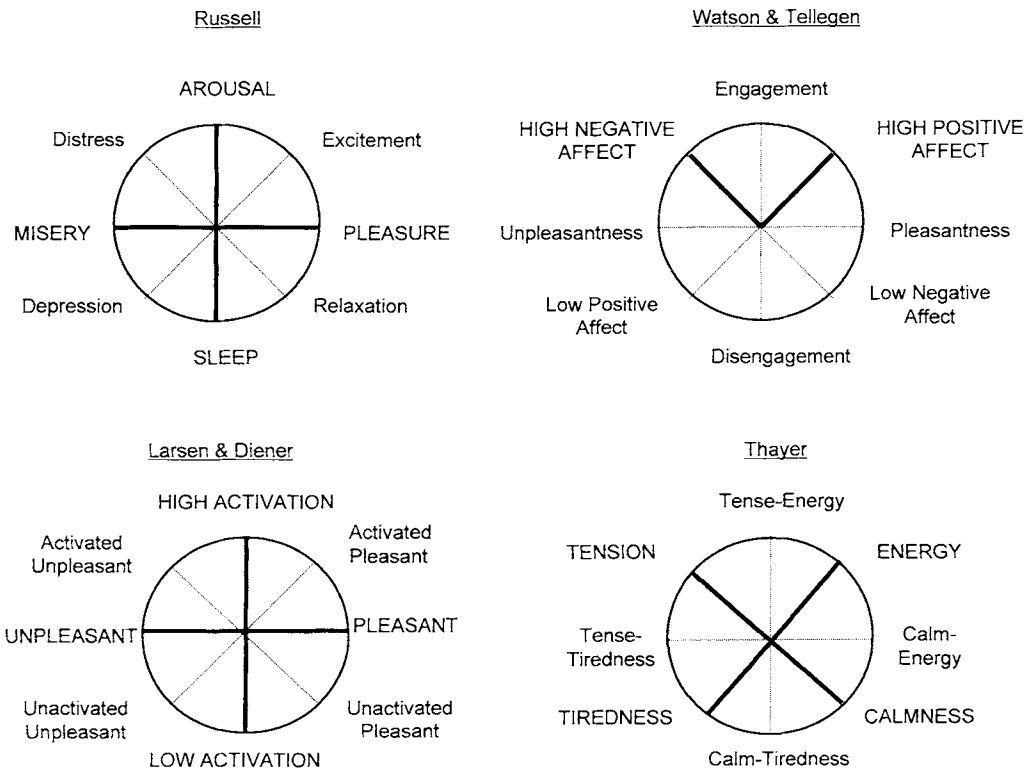

Figure 3. Four descriptive models of core affect. From Yik, Russell, and Feldman Barrett (in press).

describe the same space, sometimes with a 45° rotation. And indeed, the same data set can be analyzed to yield the pleasure and arousal orientation and then rotated to yield one of the schemes at 45° (Mayer & Gaschke, 1988).

We too believe that the structures of Figure 3 all describe the same space. Nevertheless, that belief can be challenged on empirical grounds. When the variously named dimensions were measured separately, they were often not correlated as Figure 3 predicts (Burke, Brief, George, Roberson, & Webster, 1989; Hutchison et al., 1996; Mayer & Gaschke, 1988; Nemanick & Munz, 1994; Russell, Weiss, & Mendelsohn, 1989). We interpret this failure as stemming mainly from the errors of measurement inevitably involved when observed rather than latent correlations are assessed.

To test our hypothesis in a way that reduces the impact of measurement error, we assessed various affective dimensions with D. P. Green, Goldman, and Salovey's (1993) suggested multiple-response-format procedure and used structural equation modeling to estimate the correlations between latent dimensions (Feldman Barrett & Russell, 1998; Yik, Russell, & Feldman Barrett, in press). The findings showed that Watson and Tellegen's (1985), Larsen and Diener's (1992), Thayer's (1989), and Feldman Barrett and Russell's (1998) structures were alternative descriptions of the same two-dimensional space. Pleasant–unpleasant and activated–deactivated axes accounted for 73% to 97% of the variance in the other dimensions assessed (see Table 1). These four structures have more in common than their names suggest.

Showing that the four structures of Figure 3 are empirically one and the same leaves open the question of how to interpret the combined structure. Indeed, it points to the range of possibilities. The two dimensions have been interpreted as two dimensions of valence (positive and negative; Watson & Tellegen, 1985) and as two dimensions of activation (Thayer, 1989, 1996). According to our view, both valence and activation interpretations are required to understand core affect. Watson and Tellegen's two valence dimensions implicitly involve activation; indeed, Watson et al. (1999) changed the name of the two to reflect this shared activa-

Table 1
Variance in Latent Affect Constructs Accounted for by Pleasantness and Activation

Construct	% Variance accounted for
Watson and Tellegen (1985)[a]	
High versus low positive affect[b]	92
High versus low negative affect	97
Larsen and Diener (1992)[c]	
Activated pleasant versus deactivated unpleasant	83
Activated unpleasant versus deactivated pleasant	81
Thayer (1989)[c]	
Energy versus tired	80
Tension versus calmness	73

[a] Results taken from Yik, Russell, and Feldman Barrett's (in press) Boston sample. [b] Both dimensions, Positive Affect and Negative Affect, contain a large component of activation and are therefore not pure measures of positive or negative affect. [c] Results taken from Yik et al.'s (in press) Vancouver sample.

tion. Thayer's two activation dimensions implicitly involve valence. No matter how one parses affective space, it consists of combinations of valence and activation. Positive affect (the right half of Figure 1) consists of a range of feelings that vary in level of activation, as does negative affect (the left half). High activation (the top half of the figure) consists of a range of feelings that vary in pleasure, as does deactivation (the bottom half).

Even if all four structures of Figure 3 are empirically identical, the "basic" dimensions of the resulting common space need not be orthogonal or placed where we have placed them. So, another aspect of interpretation of that space is placement of the axes. This issue is usually phrased as one of rotation.

Rotation

Our model puts emphasis on the horizontal and vertical axes of Figure 1—interpreted as pleasure and arousal—and defines all core affective states as blends of these two. And yet, alternative rotations of the structure are possible. Indeed, Watson and Tellegen (1985), Thayer (1986), and others have suggested that the basic dimensions are 45° from where we have placed them. Factor analysis, whether exploratory or confirmatory, does not determine rotation, because any set of nonredundant factors would define the space equally well.

Watson and Tellegen (1985) suggested that the axes be placed through regions where items are most densely clustered. Their rationale is a traditional one (underlying, e.g., varimax rotation): Interpretation of a dimension is clearest when items define only one dimension. Of course, finding regions of maximal item density is only one heuristic for finding interpretable dimensions. In the domain of affect, no consensus has emerged from these considerations, in part because there are between 500 and 2,000 terms in English that have to do with emotion, and the density of those items within the space of Figure 1 has not been clearly established. Figure 4 shows how 191 items drawn from different affect scales (in different formats) fall in a two-dimensional space. As is clear from this figure, item density provides no clear guidance to rotation.

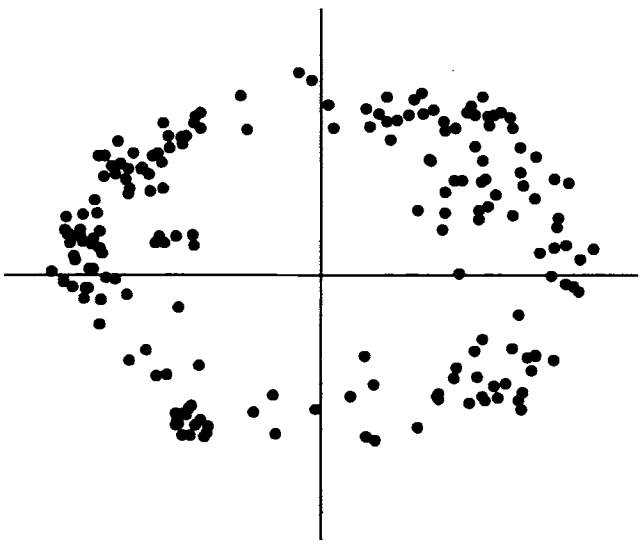

Figure 4. Two unrotated principal components of 191 affect items (N = 535). Data are from Yik (1998).

Another possibility is based on a similar rationale, but external variables rather than items internal to the analysis are used. External variables could be causes, consequences, or correlates of core affect. Larsen and Diener (1992) examined whether personality variables would cluster in specific regions of the structure but found them to be spread rather evenly. Thus, no clear guidance on the issue of rotation was provided.

Another such external variable would be a biological process, and perhaps this is the rationale behind Watson et al.'s (1999) discussion of Gray's (1987) behavioral inhibition system and behavioral activation system. One comment on Watson et al.'s discussion: Showing that an external variable correlates highly with a dimension of core affect does not speak to the question of rotation because if an external variable correlates with one dimension it will inevitably correlate with others in the structure. What is needed is the exact placement of that external variable within the entire structure.

We said that density of items and external correlates are heuristic guides to finding dimensions that are maximally interpretable. Reisenzein (1994) took a more frontal attack on the problem. He argued, and we agree, that pleasure and arousal provide conceptually separate building blocks of core affective feelings. One can make sense of enthusiasm as a blend of pleasure and arousal, of distress as a blend of displeasure and arousal, and so on. Alternative rotations of the axes do not provide such building blocks. For example, it is not clear how Watson and Tellegen's (1985) concepts of *Positive Affect* and *Negative Affect* define other concepts 45° away from them in a similar manner. From these two concepts alone, it is not clear why their co-occurrence would define surprise, astonishment, and arousal as shown in their Figure 1. (Cacioppo et al., this issue, define the simultaneous occurrence of positive and negative affect as *ambivalence.*) In their choice of new names, Watson et al. (1999) continue to reply implicitly on the same conceptual building blocks that we do: positive, negative, activation, and deactivation.

In short, rotation of the axes is part of the conceptualization of core affect. Rotation can be guided but not determined by patterns of correlation and density of items. When the level of analysis remains psychological, we find Reisenzein's (1994) argument for the pleasure–arousal rotation most persuasive. Consideration of biological processes might suggest another way to conceptualize the structure, but we have not seen a persuasive case for an alternative rotation so far.

Number of Dimensions

Intense study in a great variety of research contexts has often led to the conclusion that the number of dimensions required to describe core affect is two (for a review, see Feldman Barrett & Russell, in press). Still, alternative numbers are encountered.

Various one-dimensional descriptions of affect have been offered, and they differ from study to study. In some studies, the one dimension may be roughly what we present in Figure 1 as the horizontal axis; in other studies, roughly the vertical axis; and in

still other studies, it is at some other angle.[2] In the limited context of a given study, most of the variation might well fall along one dimension of Figure 1. Nonetheless, if various studies are to be integrated, then a broader conceptualization is needed, and much evidence points to at least two dimensions with the pattern of Figure 1. More important, when only one dimension is studied, it is very difficult to know exactly how to interpret it. It might fall at any angle in Figure 1, and, as we said, the naming and interpretation of dimensions is extremely difficult. It is time to abandon one-dimensional descriptions and assessments of affect.

The other alternative to two dimensions is more than two. Indeed, additional broad factors can be found, including potency (Osgood, 1969), dominance (Russell & Mehrabian, 1977), aggressiveness (Bush, 1973), affiliativeness (Markus & Kitayama, 1991), and locus of causation (Russell, 1978). The key question is how to interpret such dimensions. We interpret them as being concerned with the event that elicits the reaction and therefore as being outside the realm of core affect. Russell (1978) found that dimensions beyond pleasure and arousal were limited to subsets of emotion-related words and could be interpreted as (cognitive construals of) the causes and consequences of the emotion. Similarly, Smith and Ellsworth (1985) outlined a series of dimensions that were all interpreted as aspects of the (cognitive) appraisal of the emotion-eliciting situation. Such dimensions are parts of emotional episodes, but not of core affect per se, as we define it. The framework we are proposing thus limits the concept of core affect to the two dimensions of pleasure and activation, with further dimensions relegated to aspects of emotion beyond core affect. Our structure becomes two-dimensional by definition, but the definition was chosen on the basis of a long history of empirical research.

Another multidimensional description of affect can be seen in certain mood scales (Izard, 1971). The structure consists of a set of unipolar dimensions, each named by an emotion-denoting word: *joy, anxiety, stress, hostility, depression,* and so on. Each dimension describes the intensity of that specific category (such as a continuum ranging from *not at all anxious* to *extremely anxious*). There are two problems with such an approach. First, the evaluation of unipolar multidimensional structures is entwined with the issue of bipolarity (to which we turn shortly). In brief, many factors can mask bipolarity, and as these artifacts are eliminated, unidimensional affect dimensions can be shown to be parts of a bipolar space. Second, there are very many potential affective categories, and they are far from independent of one another. Indeed, they are highly correlated. Therefore, high scores on any one such dimension need not be as specific as the name of the dimension implies; high scores on an anxiety scale, for example, seem to occur for any negative mood whatsoever (Russell, 1989). When many unipolar descriptors are administered to a sample of respondents, and the correlations among the descriptors factor analyzed, the result is typically the kind of structure of low dimensionality seen in Figure 3 (Feldman, 1995a; Mayer & Gaschke, 1988; Russell, 1980; Watson & Tellegen, 1985). There are circumstances in which specific categories can be meaningfully assessed and reliably discriminated from one another, but those circumstances carry us beyond core affect to prototypical emotional episodes or at least parts of them, and verbal report alone has not been shown sufficient to establish distinctions finer than those captured by the two-dimensional spaces of Figure 3.

In sum, Figure 1 is a useful, parsimonious conceptualization of core affect. It has large advantages over one-dimensional descriptions. Further dimensions can be found but seem to carry us beyond core affect per se as we define it.

Bipolarity and Independence

What is the relation between happy and sad, between elation and depression, between positive and negative, or between tension and relaxation? Are they bipolar opposites or independent of one another? Should our self-report devices consist of unipolar scales, extending from neutral to, for example, elation? Or should assessment devices consist of bipolar scales, extending in this example from depression through neutral to elation?

Figure 1 shows affect items as bipolar opposites. Indeed, Figure 1 is thoroughly bipolar. Bipolarity has been challenged so frequently that our advocacy of bipolarity might surprise some readers. Until recently, bipolarity seemed dead, if not buried, and some form of independence had taken its place. Much progress has recently been achieved on this topic. Bipolarity is a key issue in all the articles in this Special Section, and we have explored this issue elsewhere (Carroll, Russell, & Reynolds, 1998; Feldman Barrett & Russell, 1998; Russell & Carroll, 1999). Rather than repeat ourselves here, we merely add several comments to complement the other articles in this Special Section. Despite appearances, we see no real conflict among the various positions taken once domain, terminology, and the like are clarified. Specifically, the challenge to bipolarity (and the nature of independence) has come in different forms that must be clearly distinguished from one another.

First, Cacioppo and Berntson (1994) pointed out that many scales of affect (and other phenomena) are in a bipolar format. Bipolar dimensions result from such scales not because reality is bipolar but because bipolarity is built into the scale. Cacioppo and Berntson provided a bivariate model—resulting in what might be called logical or Cartesian independence—in which alleged bipolar opposites are treated as potentially independent to allow rigorous empirical testing of bipolarity in each separate domain in which it is presupposed. In their approach to the structure of affect, bipolarity would be one of various possible outcomes to be decided by the data. We agree with all of this. We add only that, for core affect at the level of subjective experience, we believe that the data will decide in favor of bipolarity.

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[2] We use the word *roughly* twice in this paragraph because all dimensions labeled the same need not be precisely the same. For example, a positive–negative dimension may seem to be the horizontal axis, but made operational in such a way that it is actually at a 45° angle to the horizontal. Imagine that positive is made operational as happiness as induced by playing lively pleasant music, negative made operational as sadness induced by playing slow somber music; further imagine that the mood scale used as a manipulation check consists of *happy, lively,* and *active;* the sad scale consists of *sad, lethargic,* and *melancholic.* In this case, the happy–sad dimension would be the contrast between pleasant-high activation versus unpleasant-low activation. In another study, positive–negative might be made operational in such a way that it is 45° in the opposite direction. Imagine that positive is made operational as calmness induced by watching a pleasant nature film of trees swaying in the breeze, negative made operational as stress induced by watching a film of industrial accidents. The positive–negative dimension of the first study is potentially orthogonal to the positive–negative dimension of the second study.

Second, in a series of articles, Watson and Tellegen (e.g., 1985) advocated the independence of what they called Positive Affect and Negative Affect. Although their words might seem to challenge bipolarity in positive and negative affect, Feldman Barrett and Russell (1998) argued to the contrary. When Watson and Tellegen wrote about "independence," they were really writing about the number of dimensions of affect (their claim is that affect involves two independent dimensions) and not about bipolarity.[3] Indeed, both their dimensions are bipolar.

Third, various researchers, starting with Nowlis and Nowlis (1956) and including Bradburn (1969), McCrae and Costa (1991), and Diener and Emmons (1984), advocated an *empirical independence* between seeming bipolar opposites, including pleasant and unpleasant affect (often also called positive and negative affect but not to be confused with the importantly different concepts of Watson & Tellegen, 1985). In the spirit of Cacioppo and Berntson (1994), these researchers sought to separate seeming bipolar opposites and to assess their bipolarity empirically. The result was that scales or factors of what had been expected to be bipolar repeatedly emerged as weakly correlated. (Although sometimes cited alongside Watson and Tellegen's results, these weak correlations are inconsistent with their broader descriptive model, in that their dimensions are bipolar.) This empirical challenge to bipolarity and advocacy of independence presents complex and fascinating issues, including the role of time, random noise and sampling error, systematic errors of measurement such as an acquiescent response style, the use of unipolar response formats, and the specification of a precise model of bipolar opposites. Only recently have methods of overcoming most of these obstacles become available. Russell and Carroll (1999) reviewed the data available to date and argued that this psychometric challenge to bipolarity is without merit.

Fourth, Cacioppo, Gardner, and Berntson (1999) argue for *independence of mechanism*—that is, the idea that separate neurochemical mechanisms underlie positive and negative reactions to a stimulus (see also Cacioppo, Gardner, & Berntson, 1997). We do not doubt that the neurological mechanisms underlying psychological events are going to be more complex than the psychological events themselves. With over 100 billion neurons at work, neural processes are very complex. Consider the neural mechanisms underlying the elementary sensation of pitch. At the psychological level, pitch constitutes a single continuous dimension. Physiologically, pitch is represented by activity in the auditory cortices that arises from a variety of underlying neural mechanisms, including which auditory nerve neurons are firing, the firing envelope of the auditory nerve, mechanisms that analyze the harmonic structure of the sound, and, in musical contexts, those that assess the relationship of the current sound to previous and anticipated sounds. Similarly, core affect might involve multiple and functionally independent neural mechanisms that need not themselves be bipolar. Nevertheless, bipolarity may emerge in forming conscious affective feelings. According to this view, bipolarity is adaptive at the psychological level in deliberately guiding decisions, behavior, memory, and the like; bipolarity serves cognitive economy. Of course, if bipolarity is a genuine feature of core affect at the psychological level, then it is a feature that must be accounted for in some way by the neural mechanisms involved. Furthermore, as we discuss shortly, Cacioppo et al. discuss not core affect, but evaluative reactions to a stimulus. It is possible that positive and negative evaluations are independent, whereas core affect is bipolar.

Circumplex Meets Simple Structure

Even among those who agree on a two-dimensional bipolar structure of core affect, there has been controversy over simple structure versus circumplex. For example, Watson and Tellegen's (1985) model has been said to show simple structure and, for that reason, to be preferable to a circumplex (e.g., Morris, 1989; Tellegen, 1985; Watson & Tellegen, 1985; Zevon & Tellegen, 1982). Again, there is actually more agreement than such disputes suggest.

In the first place, the terms *simple structure* and *circumplex* have not always been used in a clear way. Traditionally, simple structure occurs when each variable correlates with only one of the factors of an entire structure. When the factors are orthogonal, variables fall into tight clusters 90° apart. No one suggests that affect shows this traditional simple structure. Variables form a circumplex when they intercorrelate in a way that can be represented by a circle. A circumplex is sometimes taken to require that the variables be evenly spaced around the circle (see Watson et al., 1999), but this requirement is not necessary. The actual requirement is that variables are equidistant from the center of the circle. No one suggests that individual affect items show perfectly even spacing around the circle. Further, statistical tests for circumplexity had previously been limited to certain special cases, and only recently have more general tests become available (Browne, 1992; Fabrigar, Visser, & Browne, 1997). In addition, simple structure in two dimensions is compatible with the mathematical function defining a circumplex, although incompatible with the spread of items shown in Figure 1. Finally, it is necessary to distinguish an analysis at the level of scales from that at the level of individual items. In the various structures shown in Figure 3, all the variables are defined at the level of scales. That is, each name in Figure 3 corresponds to a multi-item scale. Probably for convenience, all the investigators represented in Figure 3 converged on eight such scales evenly spaced around the perimeter of a schematic two-dimensional space. These eight variables theoretically form a circumplex (Browne, 1992).[4]

The situation is less clear when we consider individual items. Figure 1 is highly schematic, showing items spread evenly around the perimeter of the space. Figure 4 gives an empirical solution showing 191 affect items from a variety of formats placed within a two-dimensional space. In contrast, Watson and Tellegen (1985)

[3] Watson and Tellegen (1985) have what we call *independence by definition.* What Watson and Tellegen called Positive Affect is the combination of pleasantness and high activation. What they called Negative Affect is the combination of unpleasantness and high activation. The independence of Positive Affect from Negative Affect so defined follows from that definition: If pleasantness and activation are independent variables in standard score form, if Positive Affect is the sum of pleasantness and activation and Negative Affect the difference, then it is known that the sum and the difference of two such variables are correlated exactly zero.

[4] One interesting question is what happens when all four structures of Figure 3 are combined. Yik et al. (1998) explored this issue by including several scales within the same study and analyzing the correlations among the scales with Browne's (1992) CIRCUM. The scales were spread around

Table 2
Evaluation of Simple Structure After Varimax Rotation of Affective Space

		Entire affective space sampled			Watson and Tellegen's (1985) Negative Affect and Positive Affect sampled		
Sample	*N*	Coefficient of complexity	Hyperplane count	Empirical validation of simple structure	Coefficient of complexity	Hyperplane count	Empirical validation of simple structure
Sample 1	884	1.30[a]	37.5	No	1.05[a]	66.7	Yes
Sample 2	295	1.26[b]	37.5	No	1.08[c]	60.0	Yes
Sample 3	316	1.23[c,d]	27.8	No	1.14[c]	48.3	Possibly
Sample 4	183	1.18[c,d]	36.2	No	1.15[c]	58.6	Possibly

Note. Sample 3 appeared as Sample 3 in Feldman Barrett and Russell (1998).
[a] Adjectives were taken from Larsen and Diener (1992). [b] Adjectives were circumplex markers taken from Feldman Barrett (1998). [c] Adjectives were taken from Watson, Clark, and Tellegen (1988). [d] Adjectives were taken from Current Mood Questionnaire (Feldman Barrett & Russell, 1998).

emphasized that when items are restricted to single adjectives, many more fall into some regions of the space than into others. Because of varying item density, "mood terms do cluster in an orderly manner resulting in replicable simple structure solutions" (Watson & Tellegen, 1985, p. 232). What they meant is not that traditional simple structure had been achieved, but that varimax rotation, which is aimed at coming as close as possible to simple structure, yielded a reliable rotation to the more densely packed areas of the space.

Two quantitative indexes are available to assess how well items actually fit simple structure after a varimax rotation. The first index, Hyperplane Count, is the percentage of variables that have "essentially zero" factor loadings (loadings between +.10 and −.10; Cattell, 1978) on all but one factor: Perfect simple structure would achieve an index of 100% such loadings, although figures as low as 55% have been taken as acceptable (Cattell, 1978). The Hofmann Index of Complexity (Hofmann, 1978) counts the average number of factors required to explain each variable. Perfect simple structure yields a complexity index of 1.0, indicating that each variable requires only one factor to account for its variance. A perfectly evenly spaced circumplex configuration yields a complexity index of 1.5. We reanalyzed four adjective-format data sets using these two quantitative indices of simple structure. The results are shown in Table 2. When we preselected a subset of items to be markers of what Watson and Tellegen (1985) defined as Positive Affect and Negative Affect, reasonable simple structure appeared. However, when we used all the items (preselected to assess all eight variables of Figure 3), simple structure did not appear. In neither analysis did equal spacing occur. Interestingly, the average coefficient of complexity for Tellegen's original factor analyses of idiographic data (Zevon & Tellegen, 1982) was 1.31 (range = 1.20 to 1.41), demonstrating that good simple structure was not evident in their initial Negative Affect–Positive Affect configurations.

When different investigators take different theoretical stances, finer research is stimulated to sort out those differences. Our guess is that a person can feel any possible combination of pleasure and arousal (see Figure 2), and therefore we expect words to exist to define all of the regions of Figure 1. Although no one advocates the most extreme positions (traditional simple structure or perfectly evenly spaced circumplex), it may be useful to maintain a contrast between two possibilities: (a) approximately equal spacing of items versus (b) significant variations in item density such that some regions are rich in items and other regions are almost empty. To distinguish these two possibilities empirically will take finer measurement than is currently available.

the periphery of a two-dimensional space, but the gaps between scales were not exactly 45° as expected. The results were incompatible with traditional simple structure, but the indexes of fit did not show a very close fit to a circumplex either.

Physiology of Core Affect

So far, we have considered core affect on the level of subjective experience. We are, of course, not alone in taking this approach: Whatever the labels attached, self-report measures tell us how people experience their condition. Because we believe that psychological events always have neurophysiological substrates, we include those substrates in our definition of core affect.

Fortunately, we are also able to point to neurophysiological research that supports the parsing of affective space using pleasure and activation dimensions (Heller, 1993; Lang, Greenwald, Bradley, & Hamm, 1993; Lane et al., 1997). The pleasantness–unpleasantness dimension is primarily related to expressive behavior (e.g., corrugator and zygomatic muscle activation), cardiovascular responses like heart rate (Lang, Bradley, & Cuthbert, 1997), and startle reflex magnitude (Bradley, Cuthbert, & Lang, 1996; Cuthbert, Bradley, York, & Lang, 1990; Lang, Bradley, & Cuthbert, 1990).[5] In contrast, the activation dimension is primarily related to electrodermal responses (Lang et al., 1993; Lang et al., 1997). Pleasantness and activation dimensions are associated with distinct neural systems (Heilman, 1997; Heller, 1993): Pleasantness–unpleasantness is associated with asymmetric activation of the frontal lobes (possibly associated with strong projections to and from the amygdala; Davidson, 1992; Heller, 1990; Tomarken, Davidson, Wheeler, & Doss, 1992), whereas activation is associated with right parietotemporal activation (with

[5] Recent evidence suggests that the startle reflex is potentiated for high-arousal states (Cuthbert, Bradley, & Lang, 1996; Witvliet & Vrana, 1995) and that one aspect of the startle response (P3 wave of event related potential) is associated with arousal whereas the eye-blink reflex is associated with valence (Schupp, Cuthbert, Bradley, Birbaumer, & Lang, 1997).

projections to the reticular activation system in the brainstem; Heller, 1990, 1993).

Nevertheless, it has been argued that the pleasure and activation dimensions mix apples and oranges, in that pleasure and displeasure are mental states whereas activation is a physical (or physiological) state. We do not think it is useful to think of pleasure as mental and activation as physical. Both are based in neural processes, and both have an experiential counterpart to those neural processes. Further, the apples-and-oranges objection presupposes a deep philosophical mistake—namely, the notion that the mind is separable from the body (see Searle, 1992, on why this separation is a philosophical mistake). This traditional Cartesian dualism of mind and body puts the mind outside of nature. As we conceive them, pleasure and activation are states of the mind and therefore must also be states of the body, including the brain.

With pleasure and activation both defined as dimensions of experience, their exact relationship to neurophysiological substrates becomes a series of empirical questions: How do neural mechanisms compute current pleasure and current activation? How is it that we can observe bipolarity in experience, but not at the neurophysiological level? Neurochemical, physiological, and behavioral correlates of affect are being delineated, but a full understanding of how neurophysiological processes result in consciously accessible feelings (or any other mental event) remains one of the profound mysteries of psychology. Chalmers (1995) called this the hard problem of consciousness.

Comments on the Special Section

Drafts of the articles in this Special Section were circulated among the participants. To promote critical analysis, and because dialogues are more fun than collective monologues, we offer several comments on the other articles. Green, Salovey, & Truax (1999) focus on the critical issue of bipolarity and do not propose a structure of emotion. We simply admire their careful analysis and have nothing to add. Here, we therefore focus on the other two articles.

Watson et al.'s article (1999) concerns, to use our term, core affect. We say this because the data on which they draw come from participants describing their own feelings at an arbitrary point in time, whether or not other components of a prototypical emotional episode were present and whether or not the feelings were directed at a specific object. Not surprisingly, their proposed structure is remarkably similar to ours. Without implying that they endorse our views, we see a strong continuity from our view to theirs. The terms are different, but, at least on issues of structure, the substance is very close. (Their more theoretical discussion sometimes presupposes, however, that the affective reaction is directed at, or elicited by, a single stimulus.)

In contrast, Cacioppo et al.'s (1999) article concerns a subclass of emotion we have not discussed: They define an "affect system" that produces an evaluative reaction to a specific stimulus. Few such evaluative reactions would qualify as prototypical emotional episodes. Evaluative reactions likely involve corresponding changes in core affect—but not always or necessarily. Because they are centered on a stimulus, evaluative reactions are much more cognitively saturated than would be the core affect we discuss. Complex stimuli involve different aspects, and one can recognize that good and bad aspects exist simultaneously.

Thus, we propose that core affect and evaluation are separate, even if empirically related, processes. Core affect is assessed by asking how one is feeling right now. When extended over moderate lengths of time, core affect becomes a mood and is assessed by asking how one generally felt during that period. Evaluation is assessed by asking how one feels about *X*. When extended over time, evaluation becomes an attitude and is assessed by asking how one generally feels about *X*. To illustrate this difference, evaluate the items on the following list: a delicious meal, cancer, a view of a sunset, a massacre during war, a triumph for your child, and slavery. Our question is this: Did your actual core affective feelings fluctuate with the same intensity as did your evaluation as you moved from item to item? We guess that for many readers, real core affective feelings did not ride the emotional roller coaster implied by the extreme evaluations made.

The distinction between evaluation and core affect notwithstanding, Watson et al. (1999) and Cacioppo et al. (1999) both seem to agree that positive affect and negative affect are separate, independent dimensions. But do they really mean the same things by these words? If so, then their structures should be translatable one to the other. Figure 5 shows our best effort at translation. The axes represent the positivity and negativity processes postulated by Cacioppo et al. Each ranges from zero to its maximal amount. The interior of the graph shows the various possible combinations of these two independent processes. In the interior, we have superimposed terms borrowed from Watson and Tellegen's (1985) Figure 1, which is also reproduced by Watson et al. The term *quiescent* anchors the low end of their engagement dimension and seems to fall in the appropriate spot in Cacioppo et al.'s structure. Similarly, *sad* reasonably represents high negativity and lack of positivity; conversely, *happy* represents high positivity and lack of negativity.

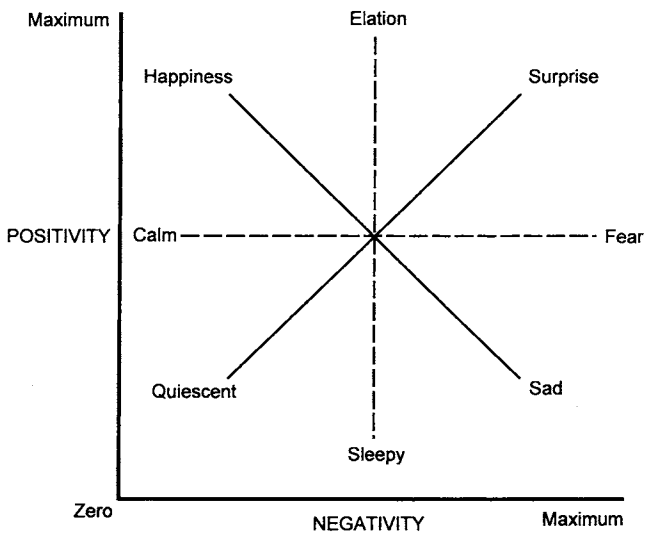

Figure 5. A hypothetical translation between Cacioppo and colleagues' (1999) independent positivity and negativity systems and Watson and colleagues' (1999) independent systems of positive activation and negative activation. The axes represent Cacioppo et al.'s (1999) two processes. The terms in the interior of the graph represent parts of Watson and Tellegen's (1985) Figure 1 structure of affect.

Yet, other terms and relations do not fit well. For Cacioppo et al. (1999) simultaneous activation of both positivity and negativity results in conflict and ambivalence. Simultaneously being both high in positive affect and high in negative affect for Watson et al. (1999) are different: surprise and astonishment. Rather than both positive and negative, surprise is neither positive nor negative. Even more counterintuitive translations occur elsewhere. Consider the three states on the graph in which negativity is maximal: sadness, fear, and surprise. According to this translation, sadness and surprise are equally negative, and what makes fear different from sadness is that fear contains much more positivity. Now consider the three states on the graph in which positivity is maximal: happiness, elation, and surprise. Happiness and surprise are equally positive, and what makes elation different from happiness is that elation is more negative.

We could not find a translation that reconciles these two structures, and we believe that the two structures are actually quite different despite their similarity in names. One is the structure of evaluations, the other the structure of core affect. This result underscores our theme: Emotion (or *affect*, as it is sometimes called) must be broken down into more specific subclasses, each carefully defined. Different structures will likely be necessary for each subclass. Core affect can be represented by a thoroughly bipolar structure, whereas evaluations might require a structure in which positive and negative are more likely independent (although for a dissenting view on the independence of evaluative attitudes, see D. Green & Citrin, 1994).

Finally, both we and Watson and his colleagues (1999) often rely on correlational data to create a descriptive structure. Cacioppo and his colleagues (1999) are concerned with underlying mechanisms and therefore rely on experimental data. Indeed, the mechanisms underlying core affect are not necessarily revealed by the correlational data that we use. Scientific inquiry is thus needed at both levels of analysis. Perhaps James (1884) put it best when he observed that descriptive structures must be constructed as part of a larger account of the causal mechanisms that generate emotion.

A Practical Guide to the Assessment of Emotion

Taxonomic structures are not everyone's cup of tea. Many researchers would like to be able to measure emotion without waiting until all the various issues mentioned in this Special Section have been fully resolved. Here we offer suggestions for readers who want to get right to work.

Our first bit of advice would be to avoid vague phrases and grab-bag terms. Sharply distinguish among various forms of emotion, such as long-term dispositions, momentary core affective feelings, full-blown prototypical emotional episodes, and affectively charged evaluative reactions. Measures suitable for one of these events may be unsuitable for another. Vague and undefined terms, especially in theoretical writing and secondary sources, make the psychological literature on emotion a nightmare. Do not assume that taxonomic structures and assessment methods developed for one form of emotion apply to another.

We have emphasized a distinction between affective reactions directed at a specific target and feelings not so directed. Time is another important but curiously often overlooked factor. In this article, we have focused on temporary events and slices in time. A whole different set of considerations applies to concepts that are necessarily extended over time (such as temperament, attitudes, or psychiatric conditions). When time is involved, the psychometrics can become surprisingly counterintuitive. To cite just one example, when pleasant and unpleasant core affect are assessed longitudinally (as in an experience-sampling diary study) with unipolar scales and then each participant's mean pleasant affect and mean unpleasant affect are calculated, bipolarity does not, as is commonly assumed, predict a substantial negative correlation between the two (Russell & Carroll, 1999; see Diener, Fujita, & Smith, 1995; Feldman, 1995b, on the empirical correlation).

Much thinking and writing on the topic of emotion is really about what we have called prototypical emotional episodes. And yet we could not find a single study that directly measured prototypical emotional episodes when addressing their structure. For prototypical emotional episodes, one must assess behavior, cognition, experience, and core affect. For example, according to our definition, the prototypical emotional episode of fear consists of a dangerous situation, a recognition of that danger, feelings of displeasure and arousal, flight, facial and vocal cues, the self-perception of oneself as afraid, and the various physiological happenings that accompany each of these. To be sure that what is being studied is a prototypical episode of fear, all components would have to be assessed. The fewer aspects assessed, the less convincing the results.

Any study that examines the feelings of all persons in a sample at some convenient point in time, without consideration of cognitions or behaviors involved, is unlikely to capture many prototypical emotional episodes. A prototypical emotional episode of fear is unlikely to be found by asking people to sit in a chair and move their facial muscles or to watch film clips. (The consequences of moving one's facial muscles or of watching film clips are interesting and worthy of study, but notice the absence of the appropriate cognition and behavior: One does not perceive danger or flee.) All such studies do, however, include core affect.

Many real and important events occur that lack one or more of the components of the prototype. The components are less correlated than was once thought (Lang, 1979; Mineka, 1979; Rachman, 1984), and therefore the safest route is to assess all the components rather than guess. For example, assessment of only the behavioral component of fear is likely to give somewhat different results than assessment of only the experience of fear. Rachman found what he called a *dissociation* between the behavior of phobics and the feelings that they report. One can feel afraid and yet approach a spider; one can refuse to approach a spider and yet report no feeling of fear.

Psychology's behaviorist tradition may suggest a behavioral measure as the safest single route. And yet, avoidance will not do: People avoid many objects with no feeling of fear or any other aspect of fear. Driving a car down the street is a continuous exercise in avoiding other cars, and yet no fear is typically involved. There is also no evidence that a specific facial or vocal expressive behavior inevitably accompanies other aspects of fear, or any other emotion (Fernandez-Dols & Ruiz-Belda, 1997), and there is no evidence that a specific pattern of peripheral physiological activity inevitably accompanies other aspects of fear (or any other emotion; Cacioppo et al., 1993; Zajonc & McIntosh, 1992).

Self-reports may be the single best indicator of a prototypical emotional episode—in many situations, people are good reporters—but self-report is not sufficient. A person need not categorize his or her own emotion in an objective manner. Imagine that Ralph yells at his wife when she is enjoying herself at a party, chatting with an attractive stranger. Objective observers might well conclude that Ralph was jealous, even if Ralph sincerely denied it. Later, Ralph might even come to agree. Self-report measures of each component of a prototypical emotional episode could be developed (Wallbott & Scherer, 1989) but are not typical.

More typically, self-report is restricted to a simple categorization, as provided by emotion adjective checklists. Our suggestion would be, in the absence of other information, to regard self-reported feelings (including those traditionally taken as indicative of discrete emotions) as core affect. Thus, as suggested by our structural model, the specific category of emotion reported or present in the name of the assessment device is not so important. A high score on an adjective checklist of anxiety, depression, hostility, or any other negative emotion typically predicts high scores on any other scale of negative affect. The names attached to scales are thus a poor guide to just what is being measured. We therefore suggest scoring such instruments in such a way to yield scores on the dimensions of pleasure and arousal. For us, then, to assess someone's core affect is to assess that person's position within Figure 1. There are various self-report instruments available for this purpose (Russell, Weiss, & Mendelsohn, 1989; Feldman Barrett & Russell, 1998; Mehrabian & Russell, 1974).

In sum, each of many aspects of emotion has to be considered individually. For prototypical emotional episodes, assessment requirements are severe and rarely or never met in practice. We suggest that measures of core affect scorable as to pleasure and arousal be routinely included in all research about emotion.

Concluding Remark

Few writers on the topic of emotion can resist the temptation to mention the blind men and the elephant. Core affect, prototypical emotional episodes, evaluation, and all the other crucial phenomena that are together called emotion (or affect) are as different as an elephant's tail, trunk, ears, and legs. We do not know if our proposed distinction between core affect and prototypical emotional episodes will prove the best place to begin dissecting the elephant, and we certainly do not know that we have found nature's own joints. We do believe that emotion must be broken down into more coherent units. This dissection must proceed through proposed distinctions followed by critical analysis, as begun in this Special Section, and empirical investigation.

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