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Emotions Are Real

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It is obvious that emotions are real, but the question is what kind of "real" are they? In this article, I outline a theoretical approach where emotions are a part of social reality. I propose that physical changes (in the face, voice, and body, or neural circuits for behavioral adaptations like freezing, fleeing, or fighting) transform into an emotion when those changes take on psychological functions that they cannot perform by their physical nature alone. This requires socially shared conceptual knowledge that perceivers use to create meaning from these physical changes (as well as the circuitry that supports this meaning making). My claim is that emotions are, *at the same time*, socially constructed and biologically evident. Only when we understand all the elements that construct emotional episodes, in social, psychological, and biological terms, will we understand the nature of emotion.

Keywords: emotion, affect, social construction, conceptual acts

For more than a century, scientists have been grappling with the question of whether or not emotions are real. To those not in the field of emotion research, this question seems like the perfect example of academic indulgence. Humans automatically and effortlessly experience emotion and "detect" emotion in each other (and even in nonhuman animals) routinely each and every day, so it could not be more obvious that emotions are real. To some emotion researchers, a handful of key evidence leaves them wondering whether the question is some kind of rhetorical pretense. Careful study of "behavioral adaptations" in nonhuman animals has revealed distinct neural circuits that control flight (e.g., Vazdarjanova & McGaugh, 1998), fighting (e.g., offensive attack, Lin et al., 2011; defensive aggression, e.g., Motta et al., 2009), and freezing (e.g., LeDoux, 2000);[1] recent optigenetic research shows that circuits (e.g., for fighting and mating) exist side by side within the same brain regions (e.g., Lin et al., 2011). Some of these circuits appear to generalize in humans; for example, the network that allows a previously neutral stimulus to acquire the ability to elicit a freezing response, dubbed the "fear" network, appears to exist in humans (e.g., LaBar et al., 1998) and is disrupted with people who suffer from posttraumatic stress disorder (Etkin & Wager, 2007). Other research on humans also points to the reality of emotions (see Table 1). With this sort of evidence in hand, it seems clear to many scientists that each emotion category has a unified biological basis—a subcortical circuit, a localized cortical region (or set of regions), or a profile of endocrine, inflammatory, or cardiovascular responses—in addition to a diagnostic facial expression and set of behaviors that are easily recognized in all people everywhere (barring illness). Given the weight of evidence, how could someone even ask whether emotions are real? Asking about the "realness" of emotions is also problematic in a pragmatic way—how can a science of emotion exist if emotions are not real?

As is often the case in science, what seems obvious to some people camouflages deeper questions for others. Such is the state of affairs that fuels the persistent dilemma about the reality of emotions. There is, for example, no one-to-one correspondence between a behavior and an emotion category in nonhuman animals. Freezing, fleeing, and defensive aggression are all responses to potential danger, so which corresponding circuit is the fear circuit? Is this evidence of many fear circuits? If so, then we must grapple with the scientific value of the category "fear," other than its obvious utility for communicating research findings to people who do not study emotion. If the category "fear" has scientific value, then which is the "real" fear circuit? Is defensive aggression an instance of fear, or an instance of anger? These are not idle semantic puzzles—they reveal a quandary that strikes right to the heart of how scientific induction works. Similar objections have been raised about other sources of evidence that appear, at first blush, to obviate questions about the realness of emotion (see Table 1; for reviews of the evidence that call into question the natural kind status of emotion categories, see Barrett, 2006a, 2011b; Barrett, Lindquist et al., 2007; Barrett, Lindquist, & Gendron, 2007; Lindquist et al., in press; Suvak & Barrett, 2011). Once alternative explanations are seriously tested, and methodological constraints are addressed, some scientists believe that the "realness" of emotion falls away like a house of cards.

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[1] Behavioral adaptations are highly heritable, species-general actions that a creature performs to survive or reproduce.

Table 1
Evidence for the Biological Basis of Emotion Categories

Natural kind claim	Example papers	Empirical challenges
1. Emotional behaviors: Distinct subcortical brain circuits produce emotional behaviors such as freezing, startle, maternal behavior (e.g., grooming, retrieving, and nursing pups), offensive attack, defensive aggression, vocalizations, appetitive behaviors, and mating behavior	Berridge & Kringelbach, 2008; Davis, 1992; Lin et al., 2011; Jürgens 2002; LeDoux, 2000; Motta et al., 2009; Normandin & Murphy, 2011; Numan & Insel, 2003	There is no one-to-one correspondence between a behavior and an emotion category, even in non-human animals. For example, rats perform many different behavioral responses to a threat, depending on the circumstance, and this questions whether the circuitry for freezing can be considered the circuitry for fear. Rats avoid the location of uncertain threat when they are free to move around, such as in a testing chamber with several arms (e.g., Vazdarjanova & McGaugh, 1998). When they cannot escape, and when the threat is certain, rats will respond with defensive aggression; rats will "defensively tread" by kicking bedding towards a threatening object (e.g., Reynolds & Berridge, 2008) or will attack a threatening object by attempting to jump on it and bite it (e.g., Blanchard et al., 1989). Neuronal responses to the presence of a predator (cat) v. a dominant intruder in the cage (another rat) are distinct in the rat hypothalamus, confirming that responses to threat are each supported by different neuronal circuitry (Motta et al., 2009). There are considerable and nontrivial cross-species differences in some of the circuitry that controls behavioral adaptations. As the human brain grew during evolution, it reorganized, with functional implications (Striedter, 2005), particularly for emotion (Barrett, Lindquist et al., 2007). For example, certain cortical regions project right down into the subcortical nuclei and spinal cord ganglia responsible for autonomic control of the body (An et al., 1998; Ongur & Price, 2000); these are monosynaptic connections, making it possible that these cortical regions are part of the circuit for behavioral adaptations in humans (for discussion, see Suvak & Barrett, 2011). Furthermore, it appears that experience changes the structure of some subcortical regions in humans. For example, the lateral hypothalamus (which controls autonomic outputs supporting behavioral adaptations) has a different structure in adult humans than in infant humans (whose structure looks more like a rat) (Saper, 2004).
2. Electrical stimulation: Electrical stimulation of specific neurons produces distinct emotional experiences or expressions.	Panksepp, 1998	Electrical stimulation of the human brain rarely produces a subjective experience, and when it does, it tends to produce an experience of general pleasure, displeasure, or arousal rather than a discrete emotion (e.g., Halgren et al., 1978; Sem-Jacobson. 1968; Valenstein, 1974; for a review see Barrett, Lindquist et al., 2007). Electrical stimulation of the same site produces different mental states across instances, depending on the prior state of individual and also the immediate context (for a discussions, see Valenstein, 1974). More recent examples of non-specificity include stimulating the Periaqueductal Grey (a key structure in fight or flight responses) for the treatment of chronic pain, thalamic stimulation for the treatment of depression, and subthalamic nucleus stimulation for Parkinson's Disease that induces depression (for a review, see Kringelbach et al., 2007). Deep brain stimulation works by restoring normal oscillatory activity within brain networks (as well as the balance between certain networks) and so does not isolate activity in one specific neuron or set of neurons (Kringelbach et al., 2010).

Table 1 (*continued*)

Natural kind claim	Example papers	Empirical challenges
3. Brain lesions: Individuals with lesions or atrophy in the amygdala, anterior insula, basal ganglia, and orbitofrontal cortex have difficulty experiencing or perceiving fear, disgust, and anger, respectively.	*Fear:* Adolphs et al. 1994; Bechara et al. 1995; Brierley et al. 2004; Calder et al., 2001; Feinstein et al., 2011; LaBar et al. 1995 *Disgust:* Adolphs et al. 2003; Calder et al. 2000, 2001; Kipps et al. 2007; Mitchell et al. 2005; Sprengelmeyer, 2007; Sprenglemeyer et al. 1996; 1998; Suzuki et al. 2006 *Anger*: Grafman et al. 1996	Lesion findings are plagued by a host of interpretation issues, including that a brain region might be important for how a mental event is created even when the phenomenon cannot be localized to that region, as well as the fact that most lesion-based interpretations take a static view of brain function and do not consider that the function of brain region might be determined by its neural context (see Luria, 1973; McIntosh, 2004; Shimamura, 2010). Careful probing finds that people with brain lesions rarely, if ever, have specific deficits in single emotions (e.g., Beer et al., 2006; Eslinger & Damasio, 1985; Saver & Damasio, 1991; Milders et al. 2003; Calder et al. 2010). Inconsistent findings are also common. *Fear*: Adolphs & Tranel, 1999; Atkinson et al. 2007 Adolphs et al. 2005; Tsuchiya et al., 2009. *Anger*: de Bruin et al. 1983; Deets et al. 1970; Machado & Bachevalier, 2006; Raleigh et al. 1979. Meta-analytic summaries of functional imaging results show clearly that amygdala activity is not specific to fear, insula activity is not specific to disgust, and orbitofrontal cortex activity is not specific to anger (Lindquist et al., in press); this is similar to the findings that activation in Broca's area is not specific to language (nor is Broca's aphasia attributable to damage in Broca's area).
4. Biological profiles: Distinct emotions like anger and fear have different biological profiles.	Lench et al., 2011; Moons et al., 2010; Vytal & Hamann, 2010	Studies using facial electromyography, vocal acoustics, cardiovascular response, hormones, neurotransmitters, and activation in gross anatomical brain locations or circuits (or any other measure that does not require a human judgment) have difficulty finding *consistent* and *specific* signatures for each emotion (e.g., reviews in chronological order: Duffy, 1934; Hunt, 1941; Mandler, 1975; Ortony & Turner, 1990; Turner & Ortony, 1992; Cacioppo et al., 2000; Russell, 2003; Russell, Bachorowski, & Fernandes-Dols, 2003; Barrett, 2006a; Barrett, Lindquist et al., 2007; Kagan, 2007; Mauss & Robinson, 2009; Lindquist et al., in press; Barrett, 2011b). As a result, it is not possible to literally verify whether or not a person (or non-human animal) is angry, sad, or afraid (or is in any other emotional state) using methods that do not rely on a human perceiver. It is not enough to show that an emotion is associated with any change in the face or body or brain whatsoever (e.g., Lench, Flores, & Bench, 2011; Vytal & Hamann, 2010); the changes have to be consistent for and specific to each category. Distinctions reported in one study are rarely specifically replicated in another. Studies often fail to consider alternative explanations for their findings (e.g., distinctions between anger and sadness might be due to arousal; distinctions between happiness and sadness might be due to hedonic valence; distinctions between fear and neutral might be due to uncertainty or novelty; distinctions between fear and anger might be due to approach vs. avoidance or threat vs. challenge). Arousal, valence, novelty, and threat vs. challenge each have biological correlates.

(table continues)

Table 1 (*continued*)

Natural kind claim	Example papers	Empirical challenges
5. Universal emotion recognition: People around the world easily recognize a scowl as anger, a pout as sadness, and a wrinkled nose as disgust. Even non-human animals can recognize emotional expressions.	Parr et al., 1998; Shariff & Tracey, 2011	Emotion perception findings are dependent on methodological aspects of experiments, such as the inclusion of emotion words in the judgment task (e.g., presenting a static face posing a scowl along with a few emotion words and asking participants to pick which word best matches the face). When these elements are removed from experiments, it is possible to disrupt emotion perception even in a sample of homogeneous undergraduate students (Barrett, 2011b; Barrett, Mesquita, & Gendron, 2011; Russell, 1994). Chimpanzees are able distinguish a negative face (e.g., "bared teeth") from a neutral face but have difficulty distinguishing one negative face from another (e.g., a "bared teeth face" and a "scream face," e.g., Parr et al., 1998). Rhesus macaque monkeys also have greatest success differentiating between a positive face (i.e., "play face") and either a neutral or negative face but have difficulty telling one negative face from another (e.g., Parr & Heintz, 2009).

A Disconfirmation Dilemma

The question of whether emotions are real or not is a classic example of a disconfirmation dilemma (Greenwald & Ronis, 1981). One simple solution is to define emotions, by fiat, as behavioral adaptations, thereby allowing their circuitry to serve as evidence that emotions are real. You can't shock a rat and study fear unless at the outset you define fear as the response that is elicited by a shock. This approach satisfies many researchers who want to emphasize the species-general aspects of emotion, because they are concerned with highlighting emotions as evolutionary adaptations. For many scientists who are interested in studying emotion in humans (even those who believe in evolution and who agree that emotions are adaptations of some sort), this is not really a serviceable solution. Humans don't routinely freeze, flee, or fight in emotion, and when they do, it is not always in the prescribed way (people can withdraw during anger or fight during fear). Humans also have conscious feelings of emotion that must be explained, whereas the existence of animal experiences is a subject of great debate. Knowledge about the physical basis of these behavioral adaptations is a necessary and valuable piece of the emotion puzzle, of course, but such knowledge does not, in and of itself, really answer the question of whether or not emotions are real. Some of the behaviors that we call "emotional" have innate, dedicated circuits, but this does not necessarily mean that emotions have innate, dedicated circuits.

Those who remain convinced that emotion categories are real with boundaries in nature (for recent examples, see Ekman & Cordaro, 2011; Panksepp & Watts, 2011; Shariff & Tracy, 2011) point out that the current technologies for measuring changes in the human face, voice, and nervous system are too imprecise or too coarse to find the physical basis of emotion. They rightly point out that crucial temporal factors are neglected in laboratory experiments. They argue that laboratory contexts are too contrived and are not evocative enough to trigger the intense emotions that have biological signatures. Or they try to parse emotions into subtypes, only some of which are natural kinds (e.g., Izard, 2007; Scarantino & Griffiths, 2011). These researchers have faith that with better experiments and better measures, or perhaps with more precise definitions, the biological nature of emotions will eventually be revealed and their physical reality will be confirmed. The temptation to believe this is really strong—so strong, in fact, that even a methodological behaviorist like John Watson wrote that Platonic forms of emotion must exist, even if he couldn't measure them (Watson, 1919, p. 198).

Alternatively, those who remain skeptical that emotion categories cut nature at its joints prefer to focus on data that point to the reality of *affect* (as valence and arousal, Russell, 2003; or as approach and avoidance; e.g., Lang & Bradley, 2008). Affective properties, such as pleasure and displeasure, or arousal, can be reliably measured in facial EMG, in the acoustics of the voice, in cardiovascular responses within the body, even as these measures do not reveal whether someone is angry, or sad, or happy (e.g., Cacioppo et al., 2000; Russell et al., 2003). Brain circuitry for approach and avoidance have been identified in both human (e.g., Huys et al., 2011) and nonhuman animals (e.g., Ferry & McGaugh, 2008; Ikemoto, 2010; Numan & Insel, 2003). In the extreme, this point of view has led to the claim that only affect can be measured objectively (i.e., using procedures that do not require a human perceiver) and therefore emotions must be illusions (for the best examples, see Duffy, 1934; Dunlap, 1932; Hunt, 1941).

From my perspective, a persistent disconfirmation dilemma—the inability to unequivocally answer a question with the scientific method—might be a big hint that scientists are asking the wrong question to begin with. What would happen if we replaced the question "are emotions real?" with "how do emotions become real?" Would this dissolve the disconfirmation dilemma before our eyes, leaving a clearer path forward?

How Do Emotions Become Real?

What Does "Real" Mean?

To the average person, the scene in Figure 1 contains variety of real things—a bench (a), plants (b), and a stone statue (c). To a chemist, these objects are "real" as collections of molecules or atoms. To a physicist, they are "real" as quarks and leptons, or little strings vibrating in 11 dimensions. No one would argue against the view that plants (as objects, or molecules, or subatomic

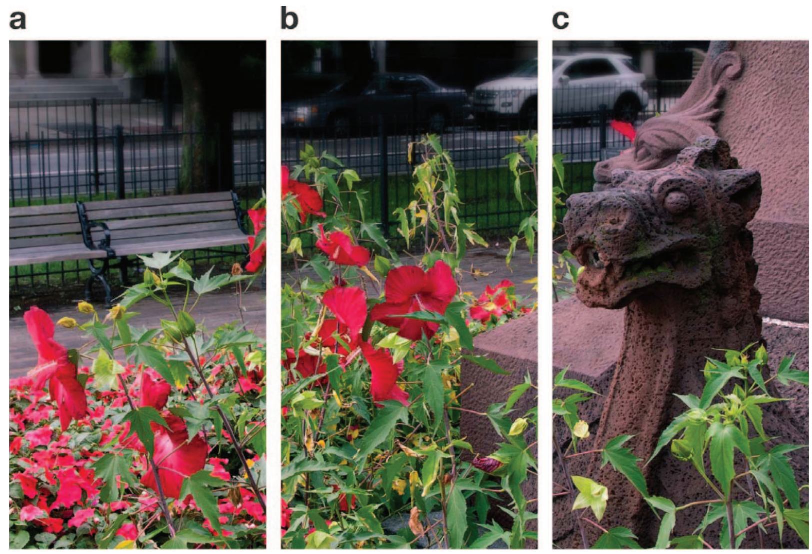

Figure 1. An illustration of social ontology. If you look at this image, you can see a variety of physically real things—a bench (a), plants (b), and a stone statue (c). If you look again, you can see another kind of real, however—flowers and weeds in a human made garden. Flowers and weeds are an example of social reality. Only someone with concepts for flowers and weeds can see them in this image.

elements of matter) exist in the natural world—that is, they are *ontologically objective*. They continue to exist even in the absence of a human mind to perceive them (i.e., they are *perceiver independent*). A close inspection of Figure 1 reveals another kind of real, however—flowers and weeds in a human-made garden. There is nothing in the physical world (no molecular make up or set of biological properties) that indicates whether a plant is serving as a flower or a weed.[2,3] A plant's status as one or the other is determined by some context—a verbal declaration involving a word or label (e.g., "this is a flower") or a meaningful situation (e.g., a rose bush is a weed if found in a vegetable patch and a dandelion can be a flower if placed in a bouquet of wildflowers). Flowers and weeds are *ontologically subjective* because they depend on human perceivers for their existence (i.e., they are *perceiver dependent*).[4]

According to the philosopher John Searle (1995, 2010), humans create ontologically subjective things as part of social reality by imposing functions on objects (and people) that are not based solely on the nature of their physical properties. Searle states this as a general rule: An object or instance (X) counts as having a certain status (Y) in a particular context (C). This status allows X to perform a particular function (or functions) not inherent to its physical structure. For example, when a plant serves as a flower or a weed, this *creates meaning* about the value of the plant: referring to a plant as a flower communicates that it is to be admired and cherished, while experiencing it as a weed brands it as something to be discarded. Flowers and weeds *prescribe actions* that mere plants cannot: flowers are to be cultivated and weeds are to be pulled from the ground. Flowers and weeds allow people to *communicate* with one another in a relational way: receiving a dandelion from your gardener, ragged with its root system attached, communicates an entirely different meaning than when receiving it from your 5-year-old child.[5] Flowers and weeds are also a form of *social influence*, in that they are a bid to control the mental state and actions of another person in a way that a mere plant cannot achieve.

Plants (X) become flowers or weeds (Y) in a human mind (C) that exists in consensus with other human minds; those minds must possess categories for flowers and weeds and agree on the categories' functions (i.e., ontologically subjective categories depend on *collective intentionality* for their existence). Sometimes other

[2] For a similar example, see Shweder (1995).

[3] Food is a similar category. For example, the stock plant for modern carrots (named Queen Anne's Lace) is considered a flower by some and a weed by others. Tomatoes, before they were considered a fruit (which would not be taxed), were a vegetable (which could be taxed), and before that they were considered a weed.

[4] Of course, the distinction between ontologically objective and subjective categories is fuzzy, because all concepts for the natural world are created by active human perceivers who exist in a chorus of other human perceivers. And the act of labeling a phenomenon is never separate from the act of communicating about that phenomenon to other people. The concept of a "quark," for example, is a category that physicists concocted to stand in for something that they believe to exist in the natural world. It is not as if we can pull the curtains of our own subjectivity back so that we have an unencumbered view of the physical world. As Einstein wrote, "Physical concepts are free creations of the human mind, and are not, however it may seem, uniquely determined by the external world." (Einstein & Infeld, 1938, p. 33).

[5] There are lots of examples of ontologically subjective categories that humans have created as a part of social reality. A piece of paper (or salt, a shell, barley, or any other form of human currency) does not derive its function as money from its molecular structure—it acquires value when people agree on its value by their willingness to trade it for material goods.[1] A person's race as "black" or "white" does not derive from the melatonin concentration in his or her skin—these categories did not even exist until it was necessary to quantify the value of a human life for the purposes of slave trading many centuries ago. And, of course, it is possible to have a very sophisticated empirical science of ontologically subjective things (e.g., economics and sociology, respectively).

minds are present at the moment of perception (as when my husband brings me shockingly yellow dandelions in a bouquet of coneflowers). Sometimes they are implied (as when I leave clover in the ground now for my daughter to smell later). Other minds might be completely absent at the proximal moment of perception (as when I buy Queen Anne's Lace and place it in a vase on my desk because it reminds me of a close friend); but even then the realness of flowers and weeds nonetheless depends on those minds in some distal way, because other minds were necessary to transmit the categories in the first place. Just how that learning takes place is a topic for another paper; for now, it is enough to propose that every instance of a flower or a weed involves the act of categorization that occurs when a perceiver is making sense of the physical world. Verbal declarations (i.e., words) often, but not always, accompany such categorizations, but even when they do not, words are important to the formation and function of the categories (cf. Barrett, Lindquist, & Gendron, 2007). Most humans are not aware of their ability to create social reality in conjunction with other humans—we just do it automatically, efficiently, and (ironically) naturally (meaning, the ability to create ontologically subjective reality is itself an objectively real consequence of how the human brain works).

Of course, flowers and weeds (or any subjectively real objects or events) are not absent from the physical world. A flower or a weed cannot be brought into existence without a plant. Rather, the point is that, in a given instance, the physical nature of a flower or a weed (Y) goes beyond just the plant (X) itself—it also involves the top-down, conceptual machinery responsible for human perception available inside the brain of the perceiver (which for our purposes, can be thought of as C). An illustration of this top-down machinery in action can be found in Figure 2. This is the same mental machinery that creates and transmits human culture. Thus, it is possible to have a science of how ontologically subjective things are created—this science is called psychology. Understanding how the human brain (in certain instances, C) creates a flower or a weed (Y) from a mere plant (X) is really the question of how flowers and weeds come into existence (because without the perceiver, there is only a plant). This is the kind of question we should be asking ourselves about emotions.

Emotions as Social Reality

Physical actions and body states, like plants, exist in nature. But the status of these physical changes as instances of anger, sadness,

Figure 2. An illustration of top-down influences in perception. As you look at this image, your brain is doing many things simultaneously—your early visual cortex is encoding the lines and edges within the black and white splotches; your meaning making machinery is trying to make sense of what this visual image is and your amygdala is firing because the image is novel and you are uncertain what it represents; all the while, your orbitofrontal cortex, subgenual anterior cingulate cortex, and anterior insula are conversing with your body. These things do not happen in linear order—in fact, they are all initiated within a few hundred milliseconds after you moved your eyes towards the image. These processes interacted with each other over the few moments when you held that image within your gaze. Even as you focus your attention to read these words in the figure note, the neural representation of that image is still alive, and your brain is trying to work out what it is. Now look at the first image in the Appendix, and then look again at this image. (After looking at the Appendix, Figure A-1) Now that you have had a prior experience that can be used to make sense of the visual input, you can see an object. As a consequence, your amygdala has reduced its firing, but your default network, along with the anterior temporal lobe and inferior frontal cortex might be firing more. Now that you can literally see the object, it exists. And it will be very difficult for you to "unsee" it. In fact, it is likely that you will never again see mere blotches of black and white in this image. The lesson here is that the brain has a terrific ability to create a whole percept that is greater than the sum of its parts. But as scientists, we must not be fooled into thinking there are no parts. Our job is to identify the parts and how they interact to make the emergent wholes.

or fear (or even as instances of some other psychological category like a cognition or perception) is created in the same way that a plant becomes a flower or a weed: with a human mind making meaning of physical events. Via this meaning, physical changes acquire the ability to perform functions that they do not have on their own (creating social meaning, prescribing actions, allowing communication, and aiding social influence).

Humans create ontologically subjective categories to serve functions that help constitute social life. According to Searle, such functions are the glue that holds a human society together. If emotion categories are ontologically subjective categories, then they can be thought of as collective cognitive tools that allow members of the same culture (and even different cultures, depending on the categories, of course) to represent and shape the social meaning of physical events. Category knowledge about emotions does not cause emotions in a mechanistic way—it constitutes emotions by adding epistemologically novel functions to actions and body states. Said another way, an emotion is an intention that is enacted when embodied conceptual knowledge is brought on line to shape the perception of a physical state, binding that physical state to an event in the world (so that it becomes something more than a mere physical sensation). This view is consistent with a variety of models that define emotions as functional states (Cosmides & Tooby, 2000; Frijda, 1986; Mesquita & Albert, 2007; Oatley, 1992). A body state or an action has a certain physical function (e.g., changes in respiration might regulate autonomic reactivity or widened eyes increase the size of the visual field), but these events do not intrinsically have certain functions *as an emotion*; events are assigned those functions in the act of categorizing them as emotion during the construction of a situated conceptualization. A partial list of functions is presented in Table 2.

If this hypothesis is correct, then it means that (1) emotions are real in the social world and (2) each instance of emotion achieves its realness in the same way as instances of other social categories (via top-down conceptual knowledge that shapes human perception). In this approach, emotions are not illusions—they are real events deserving scientific study—but measuring facial muscle movements, vocal acoustics, cardiovascular responses, or chemicals like hormones and neurotransmitters alone will never capture the phenomenon and therefore cannot reveal the nature of emotions. The meaning-making process must also be understood and measured.

In the Conceptual Act Theory of emotion (Barrett, 2006b, 2009, 2011a; Barrett & Kensinger, 2010; Lindquist & Barrett, 2008; Wilson-Mendenhall et al., 2011), which is a psychological con-

Table 2
Functions of Transforming Physical States and Actions (X) Into Emotions (Y)

Function	Elaboration
1. Linking the body to the world to create meaning	As a body state or action becomes an emotion, a perceiver is *making sense* of how events associated within the body relate to the immediate circumstances outside the body. Coordinating changes in the body to the world, and making meaning of this linkage, is one of the brain's primary jobs. In principle, this idea is consistent with the models that describe emotions as containing relational themes (e.g., Frijda, 1986; Lazarus, 1991). In the view being developed here, however, there is no one-to-one link between an emotion and a theme. Even the physical states of non-human animals take on a relational meaning when they are perceived as emotions. For example, fear is something more than just the act of freezing with its concomitant physiological changes in the body. When a human perceives physical changes as fear (say, in a rat), this perception communicates something about the psychological meaning of those changes in relation to a specific situational context, such as danger. The idea that emotions, as ontologically subjective categories, serve the function of creating meaning is consistent with the idea that emotions can be described by appraisal dimensions (cf. Barrett, Mesquita, et al., 2007), as long as appraisals reflect the descriptive properties of experience (for examples of these appraisal approaches, see Clore & Ortony, 2008; Smith & Ellsworth, 1985) and are not considered computational mechanisms that cause emotion (for a discussion of different appraisal models, see Gross & Barrett, 2011; Moors, 2009). Emotions have also been called embodied appraisals of the world (Prinz, 2004). The current view is also consistent with the ideas that emotion categories are theories (Clore & Ortony, 1991) or scripts (Russell, 1991) about what emotions are and how they work, or complex narrative schemes that give meaning to changes in the body (Shweder, 1994).
2. Regulating action	Emotions, as ontologically subjective categories, prescribe subsequent action, and so can be thought of as mental tools for *self-regulation* – an emotion is a prediction for the most functional action to be taken in the next moment, given the specific situation at hand (cf. Barrett & Gross, 2001). A change in heart rate (X) can function as a feeling of offense (Y_1) or a feeling of threat (Y_2), depending on the situated conceptualization that is constructed, and each will dictate a different action tendency; this is an example of the more general hypothesis that situated conceptualizations prepare a person to act (Barsalou, 2009). It is also consistent with the idea that emotions are states of action readiness (e.g., Bull, 1945; Dewey, 1895; Frijda, 1986), although in the present view, there is no one-to-one link between an emotion and a specific state of action readiness in the absence of a specific context or situation.
3. Communication	Emotions also function to *communicate* the meaning of physical actions and body states to others and to broadcast future intent. To declare "I am angry" or "I am afraid" creates intention in the listener (either towards the speaker to towards the broader situation). In this way, such declarations, whether or not they are stated explicitly or made intentionally, are "theory of mind" instances. They are also a way of assigning responsibility for physical actions.
4. Social influence	As a body state and/or action become an emotion, it not only prepares a person to act, but it is can also serve as a source of *social influence*. It is a bid to regulate or control the actions of others, because an emotion obligates or constrains the set of possible actions from another person during an interaction. In this way, an emotion (in accordance with the rules of a culture) affords the opportunity to control the meaning of an interaction (Solomon, 1976).

struction approach to emotion (see Gendron & Barrett, 2009; Gross & Barrett, 2011), the key hypothesis can be restated as follows: a momentary array of sensations from the world (light, sound, smell, touch, and taste) combined with sensations from the body (X) counts as an experience of emotion or a perception of emotion (Y) when categorized as such during a situated conceptualization (C). Via categorization (which is the name of the process that constructs a situated conceptualization), sensations acquire functions that are not intrinsic to them; this occurs by adding information from past experience. As a result, new functions are not based solely on the physical properties of sensations alone (as body states or actions as represented in the physiology of the body and/or in neural activations within the brain). For example, a change in blood pressure (X_1) counts as feeling offended (Y_1) when category knowledge about anger is activated as a specific, embodied representation of anger (C_1). A smile on someone else's face (X_2) counts as anger (Y_2) when a different, situation specific, embodied representation of anger is activated (C_2). See Figure 3 for examples of how a single set of facial actions (an X) can become different emotional expressions (different Ys) in different contexts (different Cs). A discussion of how category knowledge is constituted as situated conceptualizations to create emotion is beyond the scope of this article (but see Barrett, 2006b; Wilson-Mendenhall et al., 2011; for an excellent discussion of situated conceptualizations, see Barsalou, 2009). Here, perhaps it is enough to say that category knowledge is not applied to make meaning from sensations in a linear, mechanistic way, after the fact.[6] Instead, the hypothesis is that over a few hundred milliseconds, knowledge from the past is reconstituted in a way that is tailored to the immediate sensory array, such that a situated conceptualization shapes those initial sensory representations, perhaps changing them, as a meaningful, momentary gestalt of emotion emerges. In this way, culture-specific experiences of emotion actually shape the physiology and actions that are observed in an emotional episode. This is a quick process—perhaps occurring in the first 150 ms or so and barely detectable by behavioral means. It is an unconscious process—you will not experience it happening. It is an ongoing process, because mental events do not occur in punctate form, like beads on string, or like discrete responses issuing from discrete stimuli—mental life is more continuous (see Spivey, 2007). There is more to say about these ideas, but the important point here is that an X *becomes* Y by *representing* it as Y. It is possible to make reasonable inferences about Y, to predict what to do with Y, to communicate our experience of Y to others, and to use Y to influence them.[7]

Collective intentionality. To create emotions (as when conjuring any aspect of social reality), there must be a group of people who agree that certain instances (e.g., body states or physical actions) serve particular functions (to make sense of the world, to direct subsequent action, to communicate intentions, to control the actions of others). That is, there has to be collective intentionality about the new functions served by the physical states and/or actions in various situations for those functions to actually work. People have to agree that the functions can be imposed on the instance, and they have to recognize when the imposition occurs, although they need not be conscious of process. So every single experience of emotion, or perception of emotion, necessarily involves invoking shared meaning, even if there is no one there to explicitly share with in the immediate moment. If a set of instances is collectively recognized to have a status as emotions that will give those instances their functions, then this, by definition, allows those instances to perform said functions. If people agree that a plant from the family Rosaceae (i.e., a rose), with brightly colored modified leaves reflecting light at 700 nm (i.e., red petals) is a flower that symbolizes passionate love, then an American Beauty's ability to communicate affection and desire on Valentine's Day is assured precisely because believing makes it so.[8] Similarly, if people agree that a particular constellation of facial actions (e.g., a scowl), cardiovascular response (e.g., a blood pressure increase), and an appraisal (e.g., a feeling of offense) is anger in a given context, then it *is* anger in that context, and it serves whatever function anger serves in that context. If some people do not have a concept of anger, then this constellation will never exist as anger for those people (i.e., it is not that they are truly angry and don't know it); if they have some other category that is shared within their culture for that constellation in a given context, and that category knowledge is applied, then the instance becomes that mental category instead (e.g., a rose functions as medicine or as food in other cultures).[9] This view is dramatically different from a natural kind hypothesis about emotion, which would presuppose that anger exists, independently of someone's ability to perceive it.

This view implies that the novel functions imparted by a situated conceptualization (C), over and above mere physical states and actions, is always relative to the values and interests of the perceivers within the culture that possesses and transmits emotion category knowledge (because those functions depend on collective intentionality). One implication from this perspective is that the reality of emotion is always embedded in a certain situation or context, even though typically the context is not made explicit. Emotions are real in a relational way. Such a view is consistent with the idea that certain situations "afford" certain emotions within a specific cultural context (e.g., Mesquita & Albert, 2007; Mesquita & Markus, 2004) and integrates a social construction approach to emotion (e.g., Mesquita et al., in press) with a psychological construction approach.

Even though collective agreement is necessary, perceivers need not be explicitly aware that collective agreement exists and can instead demonstrate knowledge of this agreement by their actions. People do not typically categorize their own or

[6] Discussions of the Conceptual Act Theory sometimes mistakenly assume this linearity (e.g., Scherer, 2009).

[7] Via the process of categorization, the brain transforms only some sensory stimulation into information. Only some of the wavelengths of light striking our retinas are transformed into seen objects, and only some of the changes in air pressure registered in our ears are heard as words or music. Similarly, only some physical changes in the body (or representations of those changes in the brain) are transformed into emotions.

[8] If people agree that a little piece of paper is money, then its value is created precisely because we are willing to trade it for material goods; if some people withdraw their agreement, then money ceases to have value for them.

[9] It is also possible for a category to exist within a culture at one time, and then cease to exist when the social landscape changes (e.g., sexual jealousy only makes sense in a culture where women are men's property or have to rely on men's investment to raise their offspring).

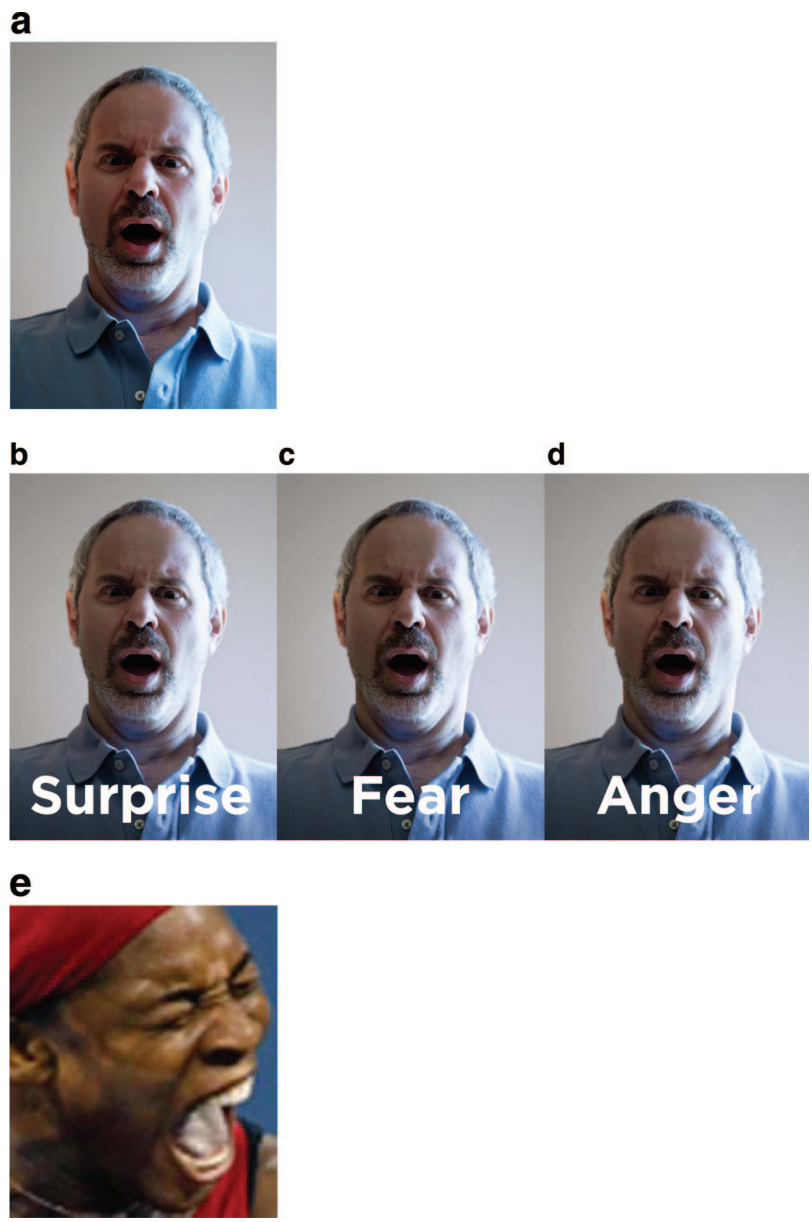

Figure 3. How different facial actions (X) become different emotional expressions (Y) in different contexts (C). Look at the facial actions posed in (a). The same face, posing the exact same facial actions, X, appears to become different emotional expressions (Y) when paired with the word "surprise" (b), "fear" (c), and "anger" (d). In these different contexts, Cs, the face actually appears to change in perceptually subtle ways. This is because embodied conceptual knowledge about emotion (residing in your brain) combines with the visual information from the posed face (on the page) to create perceptions of emotional expressions. Normally, a word need not be explicitly written down or spoken to guide a situated conceptualization in creating the perception of an emotional expression. When you look at (e), for example, words implicitly guide the situated conceptualizations of this face, X, to create a perception of fury or pain (Y). Now look at Appendix A, Figure A-2, and then come back and look at (e) again. Notice if the face looks subtly different to you. If it does, then this is because your situated conceptualization of the visual input changed based on the information that you saw in Figure A-2 (just as what you saw in Figure 2 changed once you viewed Figure A1). There is empirical evidence that contexts, such as emotion words, contribute to the creation of emotion percepts, even when emotion words are not required to explicitly judge the faces in any way (Gendron et al., in press).

Table 3
Implications of a Social Ontology Approach to Emotion

Implication	Elaboration
1. Emotion concepts help constitute an emotional episode	Emotion words and concepts, as elements of social learning, do not exist separately from emotion itself and are not psychologically inert. They are encoded as exemplars and instances in the brain and they have a constructive quality that helps create the very instances that they represent.
2. It is important to avoid the biology-social dualism	The science of emotion must stop engaging in the kind of dualist split between the biological and the social. It is not philosophically tenable to point to any biological cause of physical changes (e.g., electrical stimulation of the subthalamic nucleus causing laughter, lethargy in depression, the violent and uncontrolled movements caused by a rabies infection, etc.) as evidence that a category like happiness, sadness, or anger is physically real, and such evidence can never be a decisive argument against social construction.
3. Scientists must distinguish between scientific and commonsense categories, because they have different functions	It is important to distinguish between ontologically subjective categories that are functional for doing science and those that are functional for social communication between individuals. The fact that scientists refer to freezing as "fear" to make their research findings accessible to non-scientists in magazine articles, books and grant applications should not be considered evidence that the circuitry producing freezing reveals the physical nature of fear. It very well may be that progress in the science of emotion will occur only as we get better at separating scientific and social functions, and using different categories for each endeavor.
4. Natural explanations are possible without nativism	Every human thought, feeling, and behavior must be causally reduced to the firing of neurons in the human brain (usually with input from the body). Prior experience and learning are encoded as neuronal connections within the human brain, so even a social ontology approach to emotion must have some grounding in nature. It is possible for each instance of emotion to be described in physical terms, even if each emotion category does not have a unified biological basis (such as a subcortical circuit). This is because conceptualization or meaning-making also has physical correlates. An explanation of how human brains create ontologically subjective categories, in physical terms, is part of the natural explanation of emotions.
5. Research with non-human animals requires philosophical assumptions, whether or not these are stated explicitly	Research on non-human animals provides a crucial and necessary piece of the puzzle for understanding human emotion, but whether or not it alone reveals the nature of emotion depends on how you define emotions in the first place. It requires a philosophy of how to link the physical and the mental. I think it will never reveal the whole story. A freezing rat can never reveal the reality of fear, unless you define fear as freezing in the first place. Researchers who work with non-human animals often take the strategy of identifying a behavior that can be easily quantified and determining its neural circuitry and chemistry that underlies its plasticity, and then they define it as an emotion. Or they start with a circuit that is evolutionarily conserved and then map its behavioral correlates. This is a fine strategy for understanding behavioral adaptations, but a science of emotion also has to focus on understanding the mental states that humans name with emotion words. Such an endeavor does not require that researchers go fishing in the brain or body for this or that physical measure that will correspond to each emotion category. Other research agendas, such as the one outlined in this paper, are possible.

others' physical states or actions because they have an explicit desire to do so—categorization occurs because it is a natural function of the human brain trying to make sense of sensory input. I might water some plants in my garden while plucking others from the ground without ever explicitly wondering what I am doing, or what the plants should be called, or communicating them to others, although clearly I am using category knowledge to create flowers and weeds in this instance. Similarly, people most likely use category knowledge to create experiences and perceptions of emotions from physical changes without ever deliberately retrieving this knowledge or uttering emotion words as labels.[10]

Nor do perceivers have to agree on whether a particular instance (X) is a specific emotion (Y) on each occasion—they just have to agree that the emotion (Y) exists with certain functions in principle. One person might look at Queen Anne's Lace, see a weed, and pull it from the ground. Another might see a flower and water it. But both agree that flowers and weeds exist. Similarly, people do not have to agree that a certain action or body state is one emotion or another—they just have to possess similar categories. A patient might recount an unpleasant situation in the context of describing a great interpersonal loss, and categorize that event as anger; his therapist might categorize the instance as sadness. It cannot be said that one person is literally right and the other person is wrong in purely objective terms because there is no observer-independent criterion that can reliably and specifically adjudicate the matter. What can be said is that in this situation, an experience of anger exists for one person and a perception of sadness for the other, and one is not more real than the other. For sadness (or anger) to be real for both parties (one feeling it and the other perceiving it), they both have to impose the same function on the physical instance. So what is real about this situation is that both anger and sadness exist in this situation, and which exists for whom depends on the point of view. And, although it is not possible to say that one emotion (e.g., sadness) is more real than the other (e.g., anger), it is possible to ask whose construction

[10] Searle's (2010) example of a recession is a useful analogy—a recession can be in evidence by people's economic spending behavior, even though they might not be explicitly aware that a recession exists.

Table 4
Reframing Some Basic Questions in the Science of Emotion

Question	Reframe
Are emotions real?	How do emotions become real?
Are emotions hard-wired?	How are emotions constructed in the human brain? Which brain networks are necessary for an emotional episode to emerge and how do they interact during the construction of an emotional episode? Is it possible to identify a distributed pattern to diagnose an emotion within a human brain?
Are emotions evolved adaptations?	Which evolved mechanisms within an emotional episode are species-general? Which are species-specific?
Are emotions biological or social?	How do circuits for behavioral adaptations combine with other brain networks for creating the construction of an emotional episode as an ontologically subjective event? How do situated conceptualizations change the physical state of a person (rather than just imposing meaning on a physical state that issues from a subcortical circuit)?
Do emotion categories have essences?	What processes lead people to essentialize emotion the way they essentialize other ontologically subjective categories, such as race?

is a better fit to their culture's norms for that situation. Anger (or sadness) is not an object to be experienced or perceived with some degree of accuracy.[11]

The Physical Basis of Social Ontology

For physical actions and body states (X) to count as emotions (Y), some kind of physical change associated with meaning-making has to take place somewhere in the brain of someone. The working hypothesis offered here is that the reality of emotion involves the top-down machinery responsible for human perception available inside the brain of the emoter or perceiver (which for our purposes, can be thought of as C). In this view, an instance of emotion corresponds to an entire brain state—one that includes representations of the body and/or actions AND the additional information that is necessary to create the new functions that make emotions real—that is, the parts that are crucial for creating the situated conceptualizations that are responsible for emotional gestalts. For example, the physical state corresponding to an instance of anger is not just whatever happens in the body, in the subcortical neurons responsible for fighting, fleeing, freezing, or mating, and so forth, or in brain regions that represent or regulate the body (such as the insula, amygdala, and orbitofrontal cortex); it also includes activation in the brain regions that represent the state of affairs in the world in relation to that physical state, as understood in the context of past instances. In fact, it is possible to state a specific hypothesis here: when a body state or action counts as an instance of emotion, the brain regions that orchestrate additional information are the same ones that are engaged to create meaning during semantic processing (e.g., Binder et al., 2009), moral reasoning (e.g., Greene et al., 2004; Young et al., in press), feelings of empathy (Otti et al., 2010), theory of mind or taking the intentional stance (e.g., Jenkins & Mitchell, 2010; Mitchell, 2009), placebo responses (e.g., Wager et al., 2007), context-sensitive visual perception (Bar et al., 2006), and when remembering the past or imagining the future (e.g., Andrews-Hanna et al., 2010; Buckner & Carroll, 2007; Schacter et al., 2007; Spreng & Grady, 2010) (i.e., dorsomedial prefrontal cortex, posterior cingulate cortex, anterior temporal cortex including temporal poles, and the temporoparietal junction, otherwise known as the "default network"). A similar argument might be made for regions that are important for language and categorization, such as the anterior temporal lobe and inferior frontal cortex (e.g., Lambon et al., 2009; Thompson-Schill et al., 1997; Visser et al., 2010). So far, the available evidence suggests that these regions are consistently active during the experience and perception of emotion (for meta-analytic evidence, see Lindquist et al., in press; Wager et al., 2008). Furthermore in a developmental sense, the potential for emotion to be experienced or perceived would be created as these brain regions acquire the ability to direct and/or represent emotion category knowledge as it is learned from other people during socialization that occurs in childhood, in therapy, or during acculturation. Moreover, emotions would not exist in animals who do not possess ontologically subjective emotion categories.[12]

A further hypothesis is that like all categories in the social world, emotion categories, while learned from experience, have a biologically constructive quality of their own. Evolution has endowed us humans with the capacity to shape the microstructure of our own brains, in part via the complex categories that we transmit

[11] It is probably most precise (although immeasurably more complicated) to say that the emoter (experiencing anger) and the perceiver (seeing sadness) are not literally conceptualizing the same psychological moment, because each has access to partially unique information or Xs (i.e., his or her own physical state). They also might not share the same instances within their stored repository of prior knowledge about anger and sadness.

[12] For example, the question "is a growling dog angry?" is a meaningless question, because it includes only an X term (growling dog) and a Y term (angry) but no C term. From the perspective of a human observer (C_1), the growling dog might indeed be angry or playful, and this is not distinguishable on the basis of the fundamental or formant frequencies of the growls alone (Taylor et al., 2009; see Faragó et al., 2010 for an alternative view, although their acoustical differences between positive and negative growls could have been artifactually induced by the physical actions performed by the dogs). From the perspective of the dog (C_2), anger does not exist (although clearly there are states that correspond to embodied, situated states of affect). A similar point could be made about infants who have not yet acquired emotion categories.

to one another within the social and cultural context. This means that even though emotions are real in the social world, they both cause and are caused by changes in the natural world. They can be causally reduced, but not ontologically reduced, to the brain states that create them. To more fully explain how humans get to social reality (e.g., emotions) from the properties of the natural world—that is, to explain social reality in physical terms—it might even be necessary to consider a human brain in context (including other human brains).

Conclusions

Emotions have been essentialized as natural when in fact they are constructed. But this does not mean that emotions are illusions. And it certainly does not mean that emotions are not biological. If emotions become real in the same manner as flowers and weeds, then a science of emotion should focus on identifying the processes by which body changes and actions serve functions that they cannot perform merely by their physical properties alone. These processes involve categorization, mental state inference, and (although I did not discuss it here because of space limitations) language (but see Barrett, 2009; Barrett, Lindquist, & Gendron, 2007); all these processes can be studied at both the psychological and neurobiological levels. Said another way, an emotion is more than just a particular pattern of objective changes that reflect a diagnostic body state or a physical action—its reality derives from the way that perception works in a human mind, in conjunction with other human minds. If this is true, then a science of emotion should be focusing on the Xs (physical states and actions that occur in specific situations), the Ys (the emotion categories that exist in a particular culture), *and* the Cs (the contents and workings of the categories as situated conceptualizations that constitute emotions in a particular culture). The ability to make something socially real is not magic—it is a natural consequence of how the human brain works—and so a science of emotion must address how a brain creates instances of social reality to fully reveal the biological reality of emotion. Implications of this approach are presented in Table 3. A reframing of some basic questions about the nature of emotion within this approach is presented in Table 4.

If the past is any guide, then some researchers will continue to remain confident that emotions are real as facial movements, cardiovascular patterns, chemical substances in the body, or subcortical brain circuits, and they will continue to believe that this reality will be revealed once the field has a better set of tools or more precise scientific categories. I, myself, am not so sure. Psychology, as a science, has a huge, invisible social ontology, and I suspect it is subjective all the way down. No matter how technically savvy or experimentally sophisticated we get, we always have to map physical changes to mental categories. And this mapping will always involve some subjectivity. The categories that we use to create mental facts from physical ones (whether they are universal or culturally unique) are those that people find convenient and useful for various functions. As a result, mental categories will never be value neutral—they will always have a certain philosophy of mind and cultural worldview in which they are embedded that is relative to the needs and values of a specific group (i.e., culture) of humans. This is why even the most important mental categories in Western approaches to science—cognition, perception, and emotion—are ontologically subjective and culturally relative (cf. Barrett, 2009; Barrett & Bar, 2009; Danziger, 1997; Duncan & Barrett, 2007; Lutz, 1985). If I am right, then the science of emotion (the science of psychology, actually) should explicitly theorize about how to integrate physical, mental, and social levels of construction. This is not esoteric philosophy. It is a necessary tool for doing science.

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Appendix

Additional Images

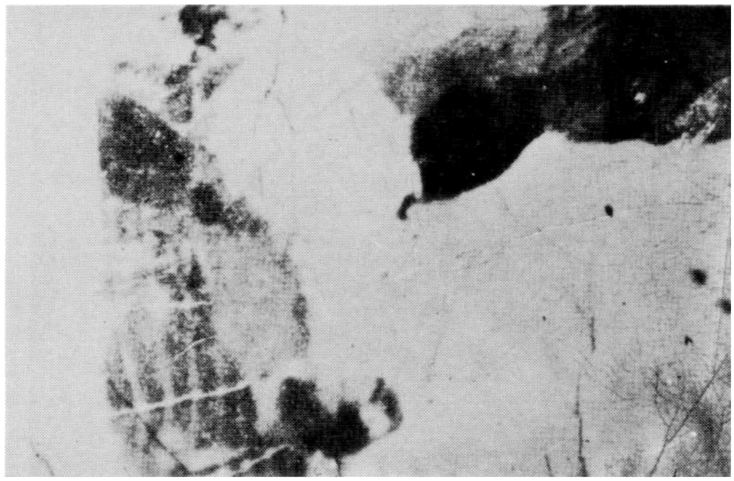

Figure A1. This is a photograph of a cow that Karl Dallenbach turned into the illusion presented in Figure 2 (Dallenbach, 1951).

Figure A2. This photograph shows an ecstatic Serena Williams after she beat her sister, Venus, in the 2008 U.S. Open tennis finals.

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