

# Emotional Experience in the Computational Belief–Desire Theory of Emotion

Rainer Reisenzein

*Institute of Psychology, University of Greifswald, Germany*

## Abstract

Based on the belief that computational modeling (thinking in terms of representation and computations) can help to clarify controversial issues in emotion theory, this article examines emotional experience from the perspective of the Computational Belief–Desire Theory of Emotion (CBDTE), a computational explication of the belief–desire theory of emotion. It is argued that CBDTE provides plausible answers to central explanatory challenges posed by emotional experience, including: the phenomenal quality, intensity and object-directedness of emotional experience, the function of emotional experience and its relation to cognition and motivation, and the relation between emotional experience and emotion. In addition, CBDTE avoids most objections that have been raised against cognitive theories of emotion. A remaining objection, that beliefs are not necessary for the emotions covered by CBDTE, is rejected as empirically unsupported.

## Keywords

affective computing, belief–desire theory of emotion, emotional experience, metarepresentation

What should a theory of emotional experience explain? A narrow answer would be that it should explain the consciously accessible properties of emotions, most prominently their peculiar phenomenality (their “feeling in a particular way”) and their intentionality or object-directedness. However, a satisfactory explanation of these properties of emotion can in my view only be given in the context of a more comprehensive theory of emotion, which also clarifies the functional role of emotions in the economy of the mind. I concur with Arnold (1960) that, to stay in contact with common experience, emotion theory should honor central folk-psychological assumptions about emotions. However, I am also convinced that some questions regarding emotions and emotional experience can only be answered, and that most others can receive a deeper answer, if one moves below the folk-psychological or “intentional” level of system analysis to the “design” level (Dennett, 1987), the level of the underlying cognitive mechanisms (see also Frijda, 1986, 2009; Gratch & Marsella, 2004; Miceli & Castelfranchi, 2002; Nichols & Stich, 2000; Oatley & Johnson-Laird, 1987).

Motivated by these considerations, I have attempted to outline (first as a sketch in Reisenzein, 1998; and in more elaborated form in Reisenzein, 1999; 2001, 2006a, 2009) a computational

model (C) of what I regard as the best explication of common-sense intuitions about emotions, the belief–desire theory of emotion (BDTE). The goal of the present article is specifically to examine emotional experience from the perspective of CBDTE. To prepare the ground, I begin with a brief summary of the main assumptions of a specific—namely, a causal—variant of the belief–desire theory of emotion, that formed the starting point for CBDTE. I then recapitulate the main assumptions of the proposed computational explication of BDTE, which, as mentioned, was motivated by the belief that computational modeling—thinking in terms of representations and computations—can help to clarify controversial issues in emotion theory. Following this, in the main part of the article, I try to document this claim by explaining how CBDTE accounts for emotional experience. Finally, I describe how CBDTE is able to handle objections that have been raised against cognitive emotion theories.

## The Belief–Desire Theory of Emotion

The belief–desire theory of emotion belongs to the broader class of cognitive emotion theories represented, for example, by the theories of Arnold (1960), Frijda (1986), Lazarus (1991), Oatley

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*Corresponding author:* Rainer Reisenzein, Institute of Psychology, University of Greifswald, Franz-Mehring-Strasse 47, 17487 Greifswald, Germany.

*Email:* [rainer.reisenzein@uni-greifswald.de](mailto:rainer.reisenzein@uni-greifswald.de)

and Johnson-Laird (1987), Ortony, Clore, and Collins (1988), and Scherer (2001) in psychology; and those of Kenny (1963), Lyons (1980), Nussbaum (2001), and Solomon (1976) in philosophy (for reviews, see Ellsworth & Scherer, 2003; Goldie, 2007). As a distinct type of theory within the cognitive approach to emotions, BDTE has, however, been promoted primarily by philosophers (see in particular Davis, 1981; Gordon, 1987; Green, 1992; Marks, 1982; Searle, 1983; and for an early version, Meinong, 1894 [summary in Reisenzein, 2006b]). Most cognitive emotion theories are *cognitive-evaluative* theories of emotion in the sense that they assume that certain kinds of cognitive evaluations or appraisals, which in their paradigmatic form are evaluative beliefs (e.g., the belief that an event is good or bad, dangerous or frustrating), are necessary for emotions. In contrast, BDTE is a *cognitive-motivational* theory of emotion: it claims that emotions depend not only on beliefs (i.e., cognitive or informational states) but also on desires (i.e., motivational states).<sup>1</sup> To illustrate the difference between the two kinds of theories, let us take as an example the case of Mary, who feels happy that *Mr. Schroiber was elected chancellor*. (For now, I identify emotions with emotional experiences. A distinction between the two is drawn later in CBDTE.) According to cognitive-evaluative theories of emotion, Mary feels happy about this state of affairs *p* if she comes to (firmly) believe that *p* obtains, and if she evaluates *p* as good for her. In contrast, the belief–desire theory of emotion assumes that Mary feels happy about *p* if she comes to believe *p* and if she desires *p*. The distinction between cognitive-evaluative and cognitive-motivational theories of emotion is not entirely strict, inasmuch as appraisal theorists usually assume that evaluations express the relevance of events for the person’s motives or desires. Still, even if this is acknowledged, important differences do remain. Most important, whereas appraisal theory proposes that the link between background desires and emotions is mediated by evaluative beliefs, BDTE denies this. Instead, emotions are directly based on desires and (typically factual) beliefs (Reisenzein, 2006b; see also, Castelfranchi & Miceli, 2009).

BDTE theorists differ, among others, with respect to the precise sense in which they take emotions to be “products of” beliefs and desires. Whereas Marks (1982) simply identifies the emotion directed at *p* with the belief-plus-desire directed at *p*, Green (1992) and Castelfranchi and Miceli (2009) assume that emotions emerge as gestalt-like wholes from the integration of their constituent belief–desire parts (Green) or from these components plus affect (pleasure or displeasure; Castelfranchi & Miceli). In contrast to both these proposals, I follow Meinong (1894, 1906) in assuming that beliefs and desires are the *causes* of emotions, which I regard with Meinong (and in line with Döring, 2009; Goldie, 2009; Helm, 2009; and Oatley’s, 2009, view of basic emotions) as mental states *sui generis*.

BDTE assumes that, by amending and refining the described belief–desire analysis, it is possible to analyze most emotions distinguished in ordinary language. In terms of the causalist version of BDTE that I endorse, this claim can be given a more precise formulation: all emotions directed at propositional objects<sup>2</sup> (i.e., states of affairs), however complex, can be understood as

reactions to the “cognized” actual (e.g., happiness, unhappiness) or potential (e.g., hope, fear) fulfillment or frustration of desires, plus, in some cases (e.g., surprise, disappointment), the confirmation or disconfirmation of beliefs (Reisenzein, 2009). In more detail, Mary is *happy* that *p* (e.g., that *Schroiber was elected chancellor*) if she desires *p* and comes to believe firmly (i.e., is certain) that *p* obtains; she is *unhappy* that *p* if she is aversive to *p* or “diswants” *p* to happen (which I shall here analyze as: she desires *not-p*) and now comes to believe firmly that *p* obtains. Mary *hopes* that *p* if she desires *p* but is uncertain about *p* (i.e., believes with uncertainty that *p* obtains); she *fears* *p* if she desires *not-p* and is uncertain about *p*. Mary is *surprised* that *p* if she up to now believed *not-p* and now comes to firmly believe *p*; she is *disappointed* that *p* if she desires *p* and up to now believed *p*, but now comes to firmly believe *not-p*; and she is *relieved* that *p* if she desires *not-p* and up to now believed *not-p*, but now comes to firmly believe *p*.

Although these emotions still comprise only a small subset of those distinguished in ordinary language, from the perspective of BDTE they are basic forms (Reisenzein, 2009) in the sense that most other emotions are variants of them, and owe their existence primarily to the fact that humans have beliefs and desires with complex contents. For example, other-regarding emotions, such as *joy for another*, *Schadenfreude*, *pity*, and *envy* can be analyzed as forms of happiness or unhappiness about, respectively, a desired or undesired state of affairs *p* that concerns the positive or negative fate of another person (e.g., Castelfranchi & Miceli, 2009; Meinong, 1894; Ortony et al., 1988). The classical “moral emotions,” such as guilt and indignation on the negative side, and pride or moral elevation on the positive side, can be incorporated into the belief–desire framework by assuming that the content of the desire (the desired proposition) in these cases is the compliance of oneself or another person with a social or moral norm (e.g., Ortony et al., 1988; Staller & Petta, 2001).

In addition to proving a parsimonious explanation of the type differentiation of emotions (happiness, fear, pity, etc.), BDTE also allows a straightforward and parsimonious explanation of the intensity of emotions. To explain emotions’ intensity, BDTE is refined by introducing quantitative concepts of belief and desire (see Reisenzein, 2009). To illustrate, let  $b(p) \in [0, 1]$  represent the degree of belief (subjective probability) in proposition *p*, and let  $d(p) \in \mathbb{R}$  represent the degree of desire concerning *p*, with positive numbers representing desire for, negative numbers aversion to, and 0 indifference about *p*. Then, for example, happiness about *p* is experienced when  $b(p) = 1$  and  $d(p) > 0$ , and the intensity of happiness about *p* is a monotonically increasing function of  $d(p)$ . Fear is experienced whenever  $0 < b(p) < 1$  and  $d(p) < 0$ , and the intensity of fear is a monotonically increasing function of  $|d(p) \times b(p)|$ . Analogous “intensity laws” can be set up for other emotions (see Reisenzein, 2009).

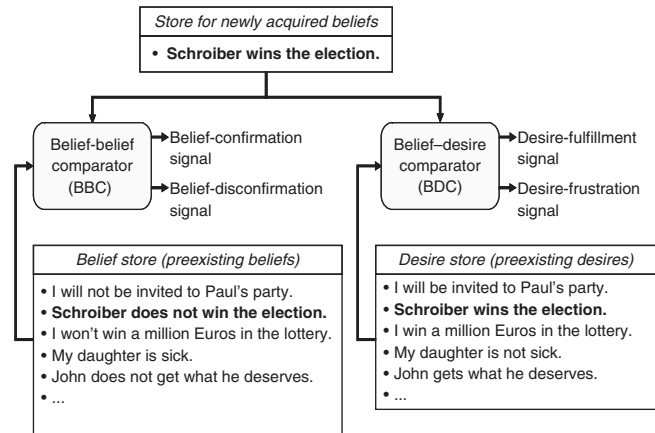
## A Computational Explication of the Belief–Desire Theory of Emotion

What cognitive architecture could support the emotion process suggested by BDTE? Given that BDTE takes emotions to be

products of beliefs and desires, this question is best addressed by first answering what cognitive architecture could support beliefs and desires. Fortunately, a plausible and transparent computational analysis of beliefs and desires exists (Fodor, 1987). According to this proposal, *believing* and *desiring* are special modes of processing propositional representations, that is, sentences in a propositional representation system, a “language of thought” (see also, Anderson & Lebiere, 1998; Gratch & Marsella, 2004). To use Fodor’s metaphor—which is just shorthand for a functional description of beliefs and desires, a description in terms of their causal roles in the cognitive system—believing that a state of affairs  $p$  obtains consists, computationally, of having a token of a sentence  $s$  representing  $p$  in a special memory store (the “belief store”); and desiring  $p$  consists of having a token of a sentence  $s$  representing  $p$  in another memory store (the “desire store”). As an illustration, Figure 1 shows Mary’s belief–desire system at the moment when she learns that Schroiber won the election. As can be seen, at this moment, Mary’s desire store contains among others the sentence “Schroiber wins the election,” and her belief store contains the sentence “Schroiber does not win the election” (temporal qualifiers have been omitted for reasons of simplicity).

CBDTE accepts this computational analysis of beliefs and desires but extends it to model emotions. According to BDTE, Mary experiences happiness about Schroiber’s election as chancellor if she desires this state of affairs ( $p$ ) and comes to believe that  $p$  obtains. To model this process, CBDTE assumes that newly acquired beliefs are stored in a separate memory. Computationally speaking, then, Mary feels happy about  $p$  when, or very soon after, a sentence token  $s$  representing  $p$  is deposited in her store for new beliefs (see Figure 1). However, the computational perspective immediately makes salient that the *simultaneous presence* of the belief that  $p$  and the desire for  $p$  in the cognitive system is not enough for happiness about  $p$  to occur. In addition, the cognitive system needs to appropriately *relate* these two facts: it needs to detect or recognize that the content of the newly acquired belief is identical to the content of a pre-existing desire. To achieve this, a mechanism is needed that compares the newly acquired belief to the preexisting desires—a *belief–desire comparator* (BDC). Parallel considerations apply to surprise. Surprise occurs if the cognitive system detects that the content of a newly acquired belief conflicts with that of a pre-existing belief. To achieve this, a mechanism is needed that compares the newly acquired belief to the pre-existing beliefs—a *belief–belief comparator* (BBC).

Computationally speaking, what the BBC and BDC do is this (Figure 1): they compare the sentence token  $s_{new}$  in the store for newly acquired beliefs with the sentence tokens in the stores for pre-existing beliefs and desires. If either a match ( $s_{new}$  is identical to a sentence  $s_{old}$ ) or a mismatch ( $s_{new}$  is identical to the negation of a sentence,  $\neg s_{old}$ ) is detected, they generate an output that signals the detection of the match or mismatch. In our example (Figure 1), Mary’s BBC detects that  $s_{new}$  representing “Schroiber wins the election,” is inconsistent with (is the negation of) the content  $s_{old}$  of a pre-existing belief; and Mary’s BDC detects that  $s_{new}$  is identical to the content  $s_{old}$  of an existing desire.



**Figure 1.** Illustration of the belief–belief and belief–desire comparators: A moment in Mary’s belief–desire system.

Consequently, Mary’s BBC outputs information about the detection of a mismatch, information that one of Mary’s beliefs has just been disconfirmed by the new information; whereas Mary’s BDC outputs information about a match, information that one of Mary’s desires has been fulfilled (Figure 1).

Actually, this description is a simplification. A more realistic model is sketched in Reisenzein (1999, 2009). This model, first, distinguishes between long-term and working memory and assumes that the comparison of newly acquired and existing beliefs and desires always takes place within working memory. Second, the model considers degrees of belief and desire and assumes, correspondingly, that the BBC and BDC compute not just matches and mismatches, but *degrees* of congruence and incongruence. Finally, the model explicitly assumes that these computations are also performed for newly acquired *uncertain* beliefs (this allows one to model fear and hope).

According to CBDTE, the output generated by the BDC and BBC has three important, immediate functional consequences in the system. First, attention is automatically focused on the content of the newly acquired belief that gave rise to the match or mismatch (e.g., in Mary’s case, Schroiber’s unexpected but desired election victory). Second, some minimal updating of the belief–desire system takes place automatically: sentences representing disconfirmed beliefs are deleted from the belief store, and sentences representing states of affairs now believed to obtain are deleted from the desire store. Third, BBC and BDC outputs that exceed a certain threshold of intensity give rise, directly or indirectly, to unique conscious feeling qualities: the feelings of surprise and “expectancy confirmation” (BBC), and feelings of pleasure and displeasure (BDC). I discuss the nature of these feelings in more detail later. Their general function is assumed to be the same as that attributed to other conscious experiences: to make information available system-wide and thereby poised to exert global control (e.g., Baars, 1988; Block, 1995; Chalmers, 1995). It should be emphasized, however, that to be “understood” by the belief–desire system, the emotional feelings need to be *conceptually interpreted*, at least

minimally (see also Barrett, 2006; Frijda, 2009; Lambie, 2009). That is, the experiencer must form a conceptualized perception of them (Döring, 2009), or even a belief about their presence; for example of the form “I experience an instance of F,” where F is a phenomenal concept (see Goldie, 2009). This is so because, to be accessible by the propositional representation system, the information contained in emotional feelings needs to be extracted, and represented in the code of that system (Jacob, 1997).

Let us next consider the question of how the comparator mechanisms are implemented. The first idea that may come to mind is that they are ordinary reasoning procedures on a par with other inference procedures that operate on propositional representations (e.g., Anderson & Lebiere, 1998), their only peculiarity being that they are metacognitive processes (because they refer to the experiencer’s beliefs and desires). To illustrate this theory, upon acquiring the belief that *p*, Mary reasons: “I desired *p*; just now I came to believe *p*; thus one of my desires is fulfilled,” and this metacognition then presumably causes Mary’s feeling of happiness about *p*. As argued elsewhere, this theory of the BBC and BDC is implausible: it does not fit with introspection, developmental data, and with computational and evolutionary considerations (Reisenzein, 1999, 2009). CBDTE therefore proposes an alternative: it asserts that the BBC and BDC are *not* ordinary inference procedures, but are special procedures “hardwired” into the brain. More precisely, they are components of the hardwired, evolved machinery that services the belief–desire system. CBDTE posits that, partly as a consequence, the comparator mechanisms have special features. In particular, they compare every newly acquired belief *automatically* (without intention, and preconsciously) and *in parallel* to the beliefs and desires currently in working memory. Furthermore, and of central importance to the main concerns of this article, the output of the comparator mechanisms is *not* propositional in nature—it is not just another sentence in the language of thought (representing the fact that a match or mismatch has been detected, as described above). Rather, the outputs of the BBC and the BDC are *nonpropositional* and *nonconceptual*: they consist of signals that vary in kind and intensity, but have no internal structure (see Oatley, 2009; Oatley & Johnson-Laird, 1987), analogous to simple sensations of tone or temperature (Wundt, 1896). They carry information about the degree of (un)expectedness and (un)desiredness of the propositional contents of newly acquired beliefs; but they do not represent the contents themselves.

In sum, CBDTE posits that the belief–desire system comes equipped with a set of hardwired monitoring-and-updating mechanisms, the BBC and the BDC. These mechanisms are, in a sense, quite similar to sensory transducers (i.e., sense organs for color, sound, touch, or bodily changes). In particular, their immediate outputs are nonpropositional signals. However, instead of sensing the world (at least directly), these “internal transducers” sense the current state and (impending) state changes of the belief–desire system, as it deals with new information. Hence, a central architectural assumption of CBDTE is that, in addition to sensors that inform us about the state of the

world, and sensors that inform us about the state of our body, we also have sensors that monitor our central representation system (see also Clore, 1994). Emotions result when the comparator mechanisms detect a match or mismatch of a newly acquired belief with preexisting beliefs (BBC) or desires (BDC). It follows that emotions are intimately related to the updating of the belief–desire system. In fact, according to CBDTE, the hardwired comparator mechanisms that service the belief–desire system, the BBC and the BDC, *are simultaneously the basic emotion-producing mechanisms*. This is in my view an important insight provided by CBDTE. Accordingly, CBDTE posits that the *evolutionary function* of the emotion mechanisms is not to solve domain-specific problems (flee the bear and fight the bull), but the domain-general task to *detect* matches and mismatches of newly acquired beliefs with existing beliefs and desires, and to *prepare* the system to deal with them once they have been detected. This conclusion agrees well with Frijda’s (1994) proposal that the emotion mechanisms are at core “concern relevance detectors,” but it extends Frijda’s proposal to the detection of “epistemic relevance.”

## Emotional Experience in CBDTE

### *Emotions and Emotional Experience in CBDTE*

**The theoretical definition of emotions.** According to CBDTE, the nonpropositional signals produced by the BBC and BDC are caused by beliefs and desires (the inputs to the emotion mechanisms), and they cause in turn emotional experiences, attentional focusing, and an updating of the belief–desire system. In fact, CBDTE assumes that the BBC and BDC output signals are the direct or indirect (partial) causes of *all* the mental and bodily manifestations of emotion, including—when they occur—facial or other expressions of emotion, physiological activation, and emotional actions (on the latter, see Reisenzein, 1996). These signals, then, are the “causal hub in the wheel of emotion.” Precisely because of their central causal role, they suggest themselves as the best candidates for the *scientific referents* of emotions. That is, the *theoretical (theory-based) definition of emotions* (Reisenzein, 2007) suggested by CBDTE is as follows: emotions are nonpropositional (nonconceptual) signals that are the immediate output of the belief- and desire-congruence detectors.

**Emotions as nonconceptual metarepresentations and as appraisals.** As already pointed out in my first sketch of the theory (Reisenzein, 1998), the CBDTE definition of emotions has two interesting implications. First, it entails that emotions are *nonconceptual metarepresentations*: emotions represent, in a nonconceptual way (e.g., Dretske, 1995; Tye, 1995), important (actual or impending) changes in the belief–desire system occasioned by new information, such as “a belief has been disconfirmed” and “a desire has been fulfilled.” Second, the CBDTE definition of emotions entails that *emotions are appraisals*, albeit a special form of appraisals. To see this, consider that the BDC and the BBC are similar, respectively, to two appraisal processes postulated in cognitive appraisal theories of emotion: the appraisal of motive-congruence, and the appraisal

of unexpectedness (e.g., Lazarus, 1991; Scherer, 2001; to be precise, unexpectedness is not an *evaluative* appraisal). CBDTE claims that these “appraisal processes” are not propositional inferences procedures that compute evaluative beliefs, but are implemented as hardwired procedures, and that their “appraisal outputs”—the nonconceptual representations of (un)expectedness and (un)desiredness—are emotions. Thus, CBDTE vindicates the intuition of those philosophical (e.g., Döring, 2007; Goldie, 2000; Helm, 2009; Meinong, 1894; Roberts, 2003) and psychological (e.g., Barrett, 2006; Frijda, 2009; Oatley, 2009; Russell, 2003) authors who assume that emotional states are, in a fairly direct and literal sense, appraisals. Still, it should be noted that these “emotional appraisals” differ from the evaluative beliefs emphasized by cognitive-evaluative emotion theorists not only in terms of phenomenality (see below) and representational format, but also in terms of informational content. To see this, consider the desire-fulfillment signal caused by Mary’s coming to believe *p*. This signal does not carry *exactly* the same information as the appraisal (evaluative belief) “*p* is good for me,” even if this is interpreted as “*p* is congruent with my motives.” Rather, the desire-fulfillment signal carries the information “a desire (of mine) has just been fulfilled by some event.” Compared to the evaluative belief, this information is in one respect scarcer, because it no longer contains a reference to *p*; but in another important respect it is richer, because it also contains the information *that some motive-congruent event has just occurred*. In fact, this is only another way of saying that the emotions are nonpropositional signals that are caused by, and hence carry information about, *both* beliefs (about what is or could be the case) *and* desires (about what should or should not be the case).

**Demarcating the field of emotions.** On the basis of CBDTE and its associated theoretical definition of emotion, the domain of emotions can in principle (i.e., given sufficient information about individual candidates for emotions) be precisely demarcated. As argued earlier, most mental states presystematically regarded as emotions are likely to retain their status in CBDTE. However, the theory also suggests what will be, for some readers, reclassifications. For example, surprise should be classified as an emotion, because of its intimate connection to the updating of the belief–desire system and its involvement in unquestioned emotions such as relief and disappointment. Conversely, if Royzman and Sabini (2001) are right that disgust is evoked by nonconceptual sensory representations rather than by a belief–desire conflict, disgust should be reclassified as a “sensory affect.”

**Defining basic emotions.** In contrast to other evolutionary theories of emotion (e.g., Ekman, 1992; McDougall, 1908/1960), CBDTE provides for a *principled* demarcation of basic emotions: the set of basic emotions comprises exactly the different outputs of the comparator mechanisms, the BBC and the BDC. At the same time, CBDTE provides no basis for drawing a strong, principled difference between “basic” and “nonbasic” emotions—all emotions that fit CBDTE, however complex or

culturally determined they may be, are equally basic in the sense that they are all products of the BDC and BBC. (However, mixtures or fusions of the basic output signals may be regarded as nonbasic; see Reisenzein, 2000.)

**Unconscious emotions.** By identifying emotions with the nonpropositional signals produced by the BDC and the BBC, CBDTE allows for the possibility of unconscious emotions. For the output signals of the BBC and CBDTE need not necessarily give rise to conscious experiences (e.g., when they are below a threshold of intensity). Nevertheless, because one central function of the BDC and BBC is precisely to make the experiencer aware that incoming information matches or mismatches existing beliefs or desires, emotions should normally be conscious. The subjective experience of emotion may simply consist in the conscious awareness of the nonpropositional signals; that is, if they exceed a threshold of intensity, these signals are experienced as feelings. Alternatively, the nonpropositional signals could activate dedicated “feeling-generators” located in subcortical brain structures (for suggestive evidence see, e.g., Barrett, Mesquita, Ochsner, & Gross, 2007; Yacubian et al., 2006), and what are experienced as, for example, surprise or pleasure, are the outputs of these feeling generators.

#### *How CBDTE Explains the Phenomenal Quality and Intensity of Emotional Experiences*

There are at least four facts about emotional phenomenality—“the way it feels” to have an emotion—that any plausible theory of emotional experience needs to explain. First, emotional experiences do have experiential quality, as opposed to having none. This most basic fact is an explanatory issue particularly for those (many; see Helm, 2009) theorists who deny phenomenal character to some kinds of conscious states, such as beliefs. Second, the experiential quality of emotions differs in characteristic ways from that of nonemotional phenomenal states (e.g., feeling tired or hungry, or seeing the Baltic sea glistening in the sun). Third, the experiential quality of emotions differs between at least some emotions (e.g., feeling happy differs from feeling unhappy or afraid). Fourth, each emotional quality can be instantiated in different intensities, from barely noticeable to highly intense (e.g., Reisenzein, 1994).

Proponents of “sensory” or “feeling” theories of emotion (the classical statements are James, 1890/1950; and Wundt, 1896), who conceptualize emotions as nonconceptual, sensation-like mental states (i.e., as analogous to sensations of color, odor, or tone) rightly view it as a strength of their theories that they are well-suited to explain the phenomenal properties of emotional experiences. For these properties are just the properties of sensations (Wundt, 1896): an experiential quality that differs between sense modality (e.g., color versus tone) and to a lesser degree also within modality (e.g., red- vs. blue-sensations), and an intensity from just noticeable to intense. Because CBDTE posits a nonconceptual, sensation-like core of emotions, it inherits the explanatory power of the “sensory” emotion theories. In more detail, CBDTE explains the phenomenality of emotions as follows:

1. The fact that emotional experiences have phenomenal quality is due, at least in significant part, to their being (belief- and desire-caused) “raw feels.” At least, these feelings make up the “affective core” (Reisenzein, 1994) of emotions (see below).
2. Emotional experiences feel different from nonemotional experiences because their “feeling core” is produced by dedicated or *unique* (i.e., specific to emotions), sensory-transducer-like brain mechanisms, the BBC and the BDC.
3. The intensity of an emotional experience at any given time point (e.g., Mary’s happiness about Schroiber’s election at time *t*) is the intensity of the feelings produced by the BBC or BDC at *t*. If several feelings of the same type co-occur, they may add up to a global feeling (for further discussion of this issue, see e.g., Gratch & Marsella, 2004; Reisenzein, 2000).
4. Different emotional experiences (e.g., happiness and fear) feel different, at least in large part, because they are or include different emotional feelings or combinations of feelings. CBDTE assumes that the BBC and BDC operate simultaneously and allows that co-occurring output signals are integrated at a subconscious level into more complex signals (e.g., the unexpectedness signal and the desire-frustration signal might be subconsciously combined into a disappointment signal). The resulting feeling mixtures or unique feelings form the affective core of pleasant and unpleasant surprise, relief, and disappointment, as well as (if the newly acquired belief is uncertain rather than certain) of fear and hope. Hence, despite their simplicity, the posited emotion mechanisms (the BBC and BDC) allow for distinct signals and consequently distinct feelings for the following emotional experiences: feeling pleased and displeased; neutral surprise and the feeling of belief-confirmation; pleasant and unpleasant surprise; disappointment and relief, hope and fear; confirmed fear (see Ortony et al., 1988) and confirmed hope.

As concerns the phenomenal quality of the remaining emotions covered by BDTE, and hence also CBDTE, such as pride, pity, envy, or guilt, at least three explanatory options exist. First, these emotional experiences may not in fact involve any phenomenal qualities beyond those mentioned. Not every *cognized* difference between emotional experiences needs to be an *experiential* difference, a difference in felt quality (Ryle, 1949). Rather, the subtler differences between emotions may be exclusively nonphenomenal differences concerning either (a) the beliefs and desires by which they are caused (e.g., Oatley & Johnson-Laird, 1987), or (b) the mental processes that they in turn cause (e.g., action tendencies; Frijda, 1986; Reisenzein, 1996). Although this issue is difficult to decide empirically, what evidence exists on the “feeling elements” of emotional experience seems compatible with a parsimonious view of emotional experiences as being essentially different forms of mental pleasure and pain (plus surprise; see, e.g., Reisenzein, 1994, 1995; Russell, 2003).

Second, the beliefs and desires that cause the metarepresentational feelings, or the mental states that they in turn elicit, may

have their own phenomenality (e.g., Parrott, 1988; Smith, 1989), which contributes to or modifies the phenomenal quality of the emotion. This possibility was suggested to me by the gestalt theory of emotional experience propounded by Castelfranchi and Miceli (2009). However, whereas these authors propose identifying the emotion with a phenomenal gestalt that emerges from the integration of pleasure or displeasure feelings with the beliefs and desires that cause them, my present proposal is just the reverse: I propose to identify the emotion with a part of the whole made up by the complete conscious state, whose phenomenal quality is influenced by the whole.

Third, there could be yet other “metarepresentational feelings.” In particular, following McDougall (1908/1960) in spirit although not to the letter, one could postulate a second belief–desire comparator that compares newly acquired beliefs with currently executed *action desires* (desires to *do* something) or intentions (cf. Mele, 1992), and produces feelings of frustration or primitive anger if this comparison yields a mismatch. Although speculative, this proposal is a straightforward extension of CBDTE.

#### *How CBDTE Explains the Object-Directedness of Emotional Experiences*

Emotions typically present themselves to the experiencer as being directed at objects. For example, Mary is happy *that Schroiber was elected chancellor*. It has often been argued that this introspective fact implies that emotional experiences must be conceptualized as intrinsically object-directed (like beliefs and desires), or at least as mental states that have an intrinsically object-directed component. However, although the directedness at objects is typical of emotional experiences, it can be questioned whether it is a necessary, intrinsic feature of them. One reason is that sometimes, emotions seem to lack objects, as in the case of moods: sometimes Mary just feels happy, without feeling happy about anything in particular.

Although moods can be handled by CBDTE in several ways, including their reinterpretation as temporary dispositions to emotions rather than as emotional episodes (see already Höfler, 1897; and Siemer, 2009), CBDTE leaves no choice with respect to emotions: it implies that the appearance of object-directedness of emotional experiences is just that—an appearance. As mentioned, emotions (the nonpropositional signals produced by the BBC and BDC) represent only the congruence or incongruence of newly acquired beliefs with existing beliefs or desires, they do not represent the contents or objects of these beliefs and desires. This implies that emotions in CBDTE cannot literally be directed at these contents or objects, for “to be directed at” here means “to represent” (e.g., Searle, 1983). In as much as emotions, from the first-person perspective, *do appear* to be directed at these objects, this appearance must therefore be an illusion. The strong point of CBDTE is that it is able to explain, at least up to a point, how this illusion occurs: it is due to the automatic focusing of attention on propositions that (mis-)match existing representations. For example, when an existing belief is disconfirmed by a newly acquired belief *Bel(p)*, the

person experiences a feeling of surprise and has her attention near-simultaneously drawn to the “offensive” proposition  $p$ . It then seems to the person that she is surprised *about*  $p$ , that her feeling *represents*  $p$  in a particular way (namely, as a *surprising* fact). The appearance of the feeling’s object-directedness might be due to an implicit causal attribution of the feeling (Clore, 1994); or to an implicit categorization of the experience (Barrett, 2006) as an instance of “being-surprised-by.” Alternatively, it seems conceivable that under the described temporal and causal circumstances, the feeling of surprise gets “bound” to the mental representation of  $p$  by a process analogous to the binding of different features of an object (e.g., shape and color) in object perception (Roskies, 1999; as Roskies points out, attention and binding are closely related). The resulting representations would presumably correspond to Lambie’s (2009) and Frijda’s (2009) “gerundival perceptions” or to Döring’s (2009) “affective perceptions.”

### Some Objections Considered

Despite the explanatory power of the belief–desire theory of emotion—which, I hope to have shown in this article, is further increased by the proposed computational explication of the theory—some emotion researchers have reservations about the theory. These reservations usually stem from a more basic concern about cognitive emotion theories in general, namely, that these theories “overintellectualize” the emotions. Emotions, it is argued, are not as tightly connected to cognition (specifically, to beliefs) as cognitive emotion theories assume.

CBDTE is able to avoid most of the concrete forms that this objection has taken. In particular, by granting that emotions are mental states *sui generis*—a unique form of centrally generated feelings—CBDTE avoids the objection of reductionism (see Goldie, 2000, this issue; and also Oatley, 2009) that can be raised against most other versions of cognitive emotion theory. Examples are the theory that emotions simply *are* evaluative judgments (e.g., Solomon, 1976), or belief–desire pairs (e.g., Marks, 1982), or evaluations (appraisals) plus arousal (e.g., Lyons, 1980).

CBDTE also avoids the important objection, targeted specifically against cognitive-evaluative (appraisal) theories of emotion, that factual and evaluative beliefs are *not sufficient* for emotions. In fact, the belief–desire theory was in part developed to answer this objection (Green, 1992; Marks, 1982; Reisenzein, 2006b; see also Castelfranchi & Miceli, 2009). For Mary to feel happy that  $p$ , it is not sufficient that she believes  $p$ , nor that she believes  $p$  and believes that  $p$  is good for her; Mary must also desire  $p$ . In fact, according to CBDTE, even Mary’s belief and desire that  $p$  are not sufficient for Mary to feel happy. In addition, Mary’s BDC must detect that the content of the newly acquired belief matches that of a pre-existing desire, and must produce an appropriate output signal. Although this will be the case under normal circumstances, happiness will not occur if the belief–desire comparator is malfunctioning (e.g., because it is blocked by a drug).

However, there is another objection against cognitive emotion theories that, if valid, is also relevant for (C)BDTE. This is the objection that beliefs are *not necessary* for emotions. Several

arguments have been advanced in support of this contention in the psychological and philosophical literature. The most important of these are that “noncognitive” (meaning here, belief-less) emotion elicitation has been found in subliminal perception experiments, and is documented by some naturally occurring cases of emotions, the paradigmatic examples being phobic fears. However, neither of these arguments is convincing.

As to the subliminal affect-elicitation experiments (see Storbeck & Clore, 2007, for a critical review), many of these studies are not directly relevant to the belief–desire theory of emotion. The reason is that they seem to deal with affects that this theory does not intend to explain, in particular sensory or aesthetic feelings (e.g., Murphy & Zajonc, 1993). With respect to those studies that deal more clearly with the affective states covered by BDTE, such as fear (e.g., Öhman & Soares, 1994), recent research suggests that the masking technique used in these studies may have been insufficient to prevent at least part of the participants from consciously recognizing the stimuli (Pessoa, Japee, & Ungerleider, 2005). Independent of these issues, *unconscious* emotion elicitation is not the same as *non-cognitive* emotion elicitation. CBDTE denies the latter, but not necessarily the former. In fact, the core emotion processes in CBDTE (the BDC and BBC) are explicitly assumed to operate automatically and unconsciously, and even their products may remain unconscious. The possibility of unconscious emotion elicitation in CBDTE thus hinges on the question of whether new beliefs can be acquired subconsciously, and I see no reason for categorically denying this possibility.

Now to the case of phobias. It is often claimed that people with phobic fears (e.g., of heights or spiders) are afraid despite being convinced that the feared situations or objects are harmless and that nothing untoward will come from them (e.g., Greenspan, 1988; Roberts, 2003; de Sousa, 1987; see also, Döring, 2009). Although this “noncognitive” theory of phobias is popular, the available systematic empirical evidence provides little support for it. On the contrary, this evidence suggests that phobics *do* have the beliefs (and desires) required for fear. For example, Jones, Whitmont and Menzies (1996; see also, Jones & Menzies, 2000) found that spider phobics confronted with a spider judged the probability of being bitten much higher, and the injury caused by a bite much worse than nonphobics (analogous findings were reported by Menzies and Clarke, 1995, for height phobics). In addition, spider phobics typically have numerous other danger beliefs apart from believing that they might be hurt. For example, many believe that if they come close to a spider, it might crawl into their clothes (Arntz, Lavy, van den Berg, & van Rijsoort, 1993). Many seem to dread mainly the bodily contact with the spider, which they expect will be disgusting (e.g., Woody, McLean, & Klassen, 2005). Hence, danger-related beliefs clearly seem to be present in people with phobic fears. Not only that, successful therapy of phobic fears eliminates the danger-related beliefs (e.g., Arntz et al., 1993; Jones & Menzies, 2000). I do not claim that these data constitute conclusive proof for the cognitive (belief) mediation of phobic fears. However, the data seem strong enough to rob the phobia cases of their persuasive force. Like the subliminal affect elicitation experiments, phobias

provide no compelling reason to reject the assumption that beliefs are necessary for fear, let alone for other emotions.<sup>3</sup>

The argument that beliefs are not necessary for emotions was one motivating reason for a number of philosophers to abandon cognitive theories of emotion, including belief–desire theory, in favor of so-called “perceptual” theories of emotion (e.g., Döring, 2007, 2009; Greenspan, 1988; Roberts, 2003, 2009), which conceptualize emotional experiences as analogous to perceptions. Although CBDTE disagrees with the perceptual theories of emotion on the question of whether beliefs are required for emotions, it finds itself in general agreement with these theories as regards the nature of emotions. In fact, CBDTE is itself a perceptual theory of emotions, for it identifies emotions with a special kind of perception. According to CBDTE, emotional experiences are conscious nonconceptual metarepresentations: they are feelings that represent to experiencers, in a nonconceptual way, important states and (impending) state changes in their core representation system, the belief–desire system, such as “a belief has been disconfirmed” (surprise) or “a desire has been fulfilled” (pleasure). In representing these changes, emotional experiences inform us at the same time about the fate of our desires and beliefs while we acquire new knowledge about the world, and about the current state of the world-as-known in relation to our preexisting beliefs and desires.

## Notes

- 1 Beliefs and desires are regarded in BDTE as fundamentally different, basic kinds of mental states—modes of relating to objects—that, accordingly, cannot be reduced to one another. In particular, desires cannot be reduced to evaluative beliefs (also see Reisenzein, 2009).
- 2 Note that philosophers use “proposition” to denote actual or possible states of affairs: the (in the simplest case) possession of a property by an object, or the holding of a relation between objects. In contrast, psychologists usually mean by “proposition” a sentence in a language-like mental code that represents a state of affairs (e.g., Anderson & Lebiere, 1998).
- 3 It should also be recalled that, according to BDTE, emotions presuppose only factual beliefs (e.g., the belief that *p* obtains) but not evaluative beliefs (e.g., the belief that *p* is bad for oneself). A further argument against the necessity of belief for emotions is that beliefs are not needed for “fantasy emotions,” emotional reactions to fiction. However, CBDTE can be extended to handle fantasy emotions, by postulating an additional memory store whose contents are not believed but only assumed to be true, and which is used for purposes of simulation (see Meinong, 1910; Nichols & Stich, 2000; Reisenzein, Meyer, & Schützwohl, 2003).

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