

Language and Emotion from the Perspective of the Computational Belief-Desire Theory of Emotion

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Abstract:

The relationship between language and emotion is discussed from the perspective of CBDTE, a computational (C) explication of the belief-desire theory of emotion (BDTE). Three claims are defended: First, natural language, humans' main medium of communication, plays a highly important role in the process of emotion generation; second, natural language is of central importance for the communication of emotions and emotion-related information; third, a language of thought (a language-like mental representation system) is required to explain human emotions.

Keywords:

Language, emotion, belief-desire theory, computational modeling, language of thought

1. Language and Emotion from the Perspective of CBDTE

The task of emotion psychology is to develop an accurate, reasonably detailed and comprehensive model of the human emotion system, including its interactions with other subsystems of the mind. Of paramount importance in the latter regard, in our view, is the clarification of the relationship between emotion and language. In this article, we examine the language-emotion interaction from the perspective of CBDTE, a computational explication of the belief-desire theory of emotion (Reisenzein, 2009a; 2009b; 2010; see also, Reisenzein, 1998; 2001, for earlier versions). We will argue that *natural language* plays a highly important role in the process of emotion generation, and is of central importance for the communication of emotions and emotion-related information. In addition, we will argue that a *language of thought* (a language-like, or propositional, mental representation system) is required to explain human emotions. In part 1 of the article, we give a summary of CBDTE. In part 2, we present arguments for our claims.

2. Précis of the Computational Belief-Desire Theory of Emotion

2.1. The Belief-Desire Theory of Emotion

CBDTE is a computational explication of the belief-desire theory of emotion (BDTE). BDTE, in turn, is a member of the family of cognitive emotion theories that have dominated discussions of emotions during the past 30 years in both psychology (e.g., Frijda, 1986; Lazarus, 1991; Oatley and Johnson-Laird, 1987; Ortony, Clore and Collins, 1988; Scherer, 2001; review in Ellsworth and Scherer, 2003) and philosophy (e.g., Lyons, 1980; Roberts, 2003; Solomon, 1976; review in Goldie, 2007). BDTE differs from the mainstream of cognitive emotion theories in a number of foundational assumptions that—or so its proponents argue—allow this theory to escape several criticisms of the mainstream view (Green, 1992; Marks, 1982; Reisenzein, 2009a; 2009b). The single most important difference to the mainstream concerns the question of the mental preconditions of emotion. The mainstream view on this issue is represented by the cognitive-evaluative theory of emotion. This theory assumes that the crucial preconditions of emotion are certain cognitive evaluations or appraisals of events, which in their paradigmatic form are *evaluative beliefs* (e.g., the belief that an event is good or bad, dangerous or frustrating). In contrast, BDTE is a *cognitive-motivational* theory of emotion: It assumes that emotions depend not only on beliefs (cognitive or informational states) but also on desires (motivational states). To illustrate, assume that Mary feels happy that *Schroiber was elected chancellor*. According to the cognitive-evaluative theory of emotion, Mary's happiness about this state of affairs *p* requires that Mary (firmly) believes that *p* is the case, and that she evaluates *p* as good for her. In contrast, according to BDTE, Mary feels happy about *p* if she comes to believe *p*, and if she desires *p*.¹ We endorse a causalist reading of BDTE, according to which the belief and desire together cause the emotion, which is regarded as a separate mental state (see Reisenzein, 2009a; 2009b).

BDTE does not aspire to explain all mental states that may be presystematically subsumed under the category “emotion” (e.g., it is probably not suited to explain disgust; Reisenzein, 2009b). However, the theory claims to be able to explain at least those emotions that seem to be directed at propositional

¹ Some proponents of the evaluative theory of emotion, particularly within psychology (where it goes under the name *appraisal theory*) acknowledge that desires (concerns, motives, goals) are also important for emotions (e.g., Frijda, 1986; Lazarus, 1991; Ortony et al., 1988; Scherer, 2001). However, they assume that desires affect emotions only indirectly, namely as the standards of comparison on which appraisals (evaluative beliefs) are based. In contrast, BDTE assumes that emotions are *directly* based on desires and (typically *factual*) beliefs, that is, without mediation by evaluative beliefs (Green, 1992; Reisenzein, 2009a; 2009b; see also, Castelfranchi and Miceli, 2009).

objects (i.e., actual or possible states of affairs). This restriction of the intended domain of application of BDTE is not very severe, however, because the set of “propositional” emotions seems to comprise most emotions distinguished by name in natural language (see also, Ortony et al., 1988; Wierzbicka, 1999). According to our causalist explication of BDTE, all these emotions are reactions to the cognized actual or potential fulfillment or frustration of desires; plus, in some cases (e.g., relief, disappointment), the confirmation or disconfirmation of beliefs (Reisenzein, 2009a). For example, Mary is *happy* that *p* (e.g., that *Mr. Schroiber was elected chancellor*) if she desires *p* and now comes to believe firmly (i.e., is certain) that *p* is the case; whereas Mary is *unhappy* that *p* if she is averse to *p* (which we analyze here as: she desires *not-p*) and now comes to believe firmly that *p* is the case. Mary *hopes* that *p* if she desires *p* but is uncertain about *p* (i.e., believes with uncertainty that *p* is the case), and 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 *not-p* if she desires *p* and up to now believed *p*, but now comes to firmly believe *not-p*; and she is *relieved* that *not-p* if she is averse to *p* and up to now believed *p*, but now comes to firmly believe *not-p*.

Happiness and unhappiness, hope and fear, surprise, disappointment and relief are basic forms of emotion in BDTE 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, emotional reactions to the fortune of others, such as *joy for another*, *Schadenfreude*, *pity* and *envy*, can be understood 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., Meinong, 1894; Ortony et al., 1988). “Moral emotions”, such as guilt or indignation on the negative side, and pride or moral elevation on the positive side, can be incorporated into BDTE by assuming that the fulfilled or frustrated desire in these cases concerns the compliance of oneself or another person with a social or moral norm (e.g., Ortony et al., 1988). For an elaboration of these ideas, see Reisenzein (2010).

In addition to accounting for the type differentiation of emotions (happiness, fear, pity, etc.), BDTE offers a parsimonious explanation of the intensity of emotions: The intensity of an emotion directed at a state of affairs *p* is a joint function of the strength of the belief and the desire concerning *p* (e.g., Davis, 1981; Reisenzein, 2009a; for empirical evidence see Reisenzein and Junge, 2006; 2011). For example, happiness is felt if one desires *p* and is certain (belief strength = maximum) that *p* is the case; presupposing this to be the case, the intensity of happiness about *p* is a monotonically increasing function of the strength of the desire for *p*.

Finally, BDTE can be extended to “fantasy emotions” (i.e., emotional reactions to fictional events), by replacing beliefs with assumptions (Meinong, 1910), or “pretend beliefs” (Nichols and Stich, 2000).

2.2. A Computational Explication of BDTE

Like most emotion theories, BDTE is formulated on the intentional level of system analysis (in Dennett’s, 1971, sense) familiar from common-sense psychology; in fact, BDTE is an explication of a core part of the implicit theory of emotion contained in common-sense psychology (Heider, 1958; Reisenzein and Mchitarjan, 2008). By taking BDTE as our starting point, we accept this piece of common-sense psychology as broadly correct. Still, we believe that several basic questions of emotion theory can only be answered if one moves beyond this level to the “design level”, the level of computational architecture (Reisenzein, 2009a; 2009b). This requires making assumptions about the representational-computational system that generates the phenomena described by BDTE. Because BDTE takes emotions to be products of beliefs and desires, what is needed is a computational architecture that supports beliefs and desires. As argued by Fodor (1975; 1987), a plausible and transparent computational analysis of beliefs and desires is possible if one assumes a propositional (language-like) system of mental representation, a “language of thought”. According to this proposal, *believing* and *desiring* are special modes of processing propositional representations, that is, sentences in the language of thought. To use Fodor’s metaphor (see also Schiffer, 1994), believing that a state of affairs p is the case consists, computationally speaking, 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”). For example, prior to Schroiber’s election, Mary desired victory for Schroiber in the election but believed that he would not win it. On the computational level, this means that prior to Schroiber’s election, Mary’s desire store contained among others the sentence “Schroiber wins the election”, and her belief store contained the sentence “Schroiber will not win the election.”

CBDTE also follows Fodor (1975) in assuming that (at least the central part of) the language of thought is innate. In particular, CBDTE assumes that the innate components of the language of thought comprise a set of hardwired maintenance and updating mechanisms (Reisenzein, 2009a). At the core of these mechanisms are two comparator devices, the belief-belief comparator (BBC) and the belief-desire comparator (BDC). As will be explained shortly, these comparators play a pivotal role in the generation of emotions. The BBC compares newly acquired beliefs to pre-existing beliefs, whereas the BDC compares them to existing desires. Computationally speaking, the BBC and BDC compare the

mentalese sentence tokens s_{new} in a special store reserved for newly acquired beliefs, with the sentences s_{old} currently in the stores for pre-existing beliefs and desires. If either a match (s_{new} is identical to s_{old}) or a mismatch (s_{new} is identical to $\neg s_{old}$) is detected, the comparators generate an output that signals the detection of the match or mismatch.

CBDTE assumes that the comparator mechanisms operate automatically (without intention, and pre-consciously) and that their outputs are *nonpropositional* and *nonconceptual*: They consist of signals that vary in kind and intensity, but have no internal structure, and hence are analogous to sensations (e.g., of tone or temperature, Wundt, 1896). These signals 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 the example, Mary's BBC detects that the sentence 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. As a consequence, Mary's BBC outputs information about the detection of a mismatch, meaning that one of Mary's beliefs has just been disconfirmed by new information. Whereas Mary's BDC outputs information about a match, meaning that one of Mary's desires has just been fulfilled.

To complete the picture, CBDTE assumes that the outputs generated by the BBC and BDC have important functional consequences in the cognitive system. First, attention is automatically focused on the content of the newly acquired belief that gave rise to the match or mismatch—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 belief contents are deleted from the belief store, and sentences representing states of affairs now believed to exist are deleted from the desire store. Third, BBC and BDC output signals 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 the feelings of pleasure and displeasure (BDC). According to CBDTE, the simultaneous occurrence of the emotional feelings, and of the focusing of attention on the contents of the beliefs that caused them, gives rise to the impression that emotions are directed at objects (Reisenzein, 2009a).

In sum, CBDTE posits that emotions are the results of computations in a propositional representation system that supports beliefs and desires. According to CBDTE, the core of the belief-desire system is innate, and this innate core includes a set of hardwired monitoring-and-updating mechanisms, the BBC and the BDC. These mechanisms are, in a sense, similar to sensory transducers (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. Emotions result when the comparator mechanisms detect a match or mismatch between newly acquired beliefs and pre-existing beliefs (BBC) or desires (BDC). Hence, according to CBDTE, emotions are intimately related to the updating of the belief-desire system. In fact, the connection could hardly be tighter: The hardwired comparator mechanisms that service the belief-desire system, the BBC and the BDC, are simultaneously the basic emotion-producing mechanisms. Correspondingly, CBDTE assumes that the evolutionary function of the emotion mechanisms is not to solve domain-specific problems (as proposed by some evolutionary emotion theorists; e.g., McDougall, 1908/1960), but the domain-general task to detect matches and mismatches of newly acquired beliefs with existing beliefs and desires, and to prepare the cognitive system (or agent) to deal with them once they have been detected.

As explained in more detail in Reisenzein (2009a; 2009b), CBDTE solves, resolves, or at least gives clear answers to several long-standing controversial questions of emotion theory. For example, CBDTE provides a precise theoretical definition of emotions (Reisenzein, 2007): Emotions are the nonpropositional signals generated by the belief- and desire congruence detectors, that are subjectively experienced as unique kinds of feelings. CBDTE also provides a principled demarcation of the set of basic emotions: This set includes precisely the different types of outputs of the congruence detectors. At the same time, however, CBDTE speaks against any sharp distinction between “basic” and “nonbasic” emotions: All emotions covered by the theory, however complex or culturally determined they might be in other respects, are equally basic in the sense that they are all products of innate, hardwired emotion mechanisms, the BBC and the BDC.

CBDTE also provides an explanation of the phenomenal quality of emotions—the fact that emotional experiences “feel in a particular way” (Reisenzein, 2009b; see also, Reisenzein and Döring, 2009). First, the fact that emotions have experiential quality at all (as opposed to having none) can be explained by CBDTE’s assumption that emotions are nonpropositional, sensory mental states, or at least contain a sensory core. Second, emotional experiences feel different from nonemotional experiences because their sensory core is produced by mechanisms that are specific to, or reserved for emotions. Third, the intensity of emotions is a direct function of the intensity of the feelings caused by the BBC and/or the BDC. Fourth, different emotions (e.g., joy or disappointment) feel different—at least for the most part—because they are, or contain, different emotional feelings or combinations of feelings. As to more complex emotions—such as joy for another, pity, moral elevation, or guilt—CBDTE assumes that their experiential quality is in fact *not* fundamentally different from that of simpler emotions, such as self-centered happiness or unhappiness. What sets the more complex emotions apart from the simpler emotions is their special cognitive-

motivational background and as a result, their “formal object” (see Reisenzein, 2010).

Additional explanatory benefits of CBDTE are described in Reisenzein (2009a; 2009b). In the remainder of this article, we try to show that CBDTE can also provide a plausible picture of the relationship between emotion and language.

3. Language and Emotion from the Perspective of CBDTE

When discussing the relationship between language and emotion from the perspective of CBDTE, one actually needs to consider *two* languages: The language of thought, and natural (spoken) language. Although a number of authors (e.g., Carruthers, 1996; Kaye, 1995) have proposed that the language of thought may simply *be* a person’s natural language (e.g., English for English speakers and German for German speakers), there are weighty reasons for assuming that the internal code that supports propositional attitudes, while linguistic, is *not* a natural language (e.g., Fodor, 1975; Pinker, 1994). In particular, positing a separate mental language allows one to assume the existence of propositional attitudes, such as beliefs and desires, not only in adult humans, but also in prelinguistic children and higher animals. This consideration is of particular importance for CBDTE, because empirical evidence suggests that at least some of the emotions covered by the theory, such as surprise and joy, also occur in prelinguistic children and higher animals (e.g., Lewis, 2000). We therefore follow Fodor (1975) in assuming that the language of thought and natural language are distinct representation systems: Whereas the language of thought is humans’ primary medium of *thinking*, natural language is their primary medium of *communication* (see also, Pinker, 1994). Accordingly, the communication of thoughts (sentences in the language of thought) involves their translation into a natural language, whereas understanding verbal communications requires translating them from the natural language in which they are uttered into the language of thought.

In the following two sections of the article, we focus on the relationship between emotions and *natural language*; in the last section, we briefly discuss CBDTE’s assumption that emotions require a *mental language*. As will be seen, one reason for making this assumption is precisely because it seems to be needed to account for the relationship between emotions and natural language.

3.1. The Role of Verbal Communications in Emotion Generation

Readers of psychological works on emotion could easily get the impression that human emotions are typically evoked by sense-perceptions resulting from

personal encounters with nonsocial events, such as meeting a bear in the wilderness (James, 1890/1950) or encountering a snake in the grass (LeDoux, 1998). The emphasis on such cases as presumed paradigms of emotion elicitation has been fostered by the individualistic orientation of emotion psychology; that is, the tendency of emotion psychologists to construe the individual as a solitary information processor, who must deal all by himself with the events that occur to him or her (for exceptions to this trend see e.g., Parkinson, Fischer and Manstead, 2005; Reisenzein, 2001). However, this view of *Homo sapiens* is misleading. Far from being a solitary species, humans are unique among higher animals in being characterized by *ultrasociality*, the capacity to live in large cooperative groups (e.g., Richerson and Boyd, 2005). Presumably, several different adaptations had to come together to allow ultrasociality in humans to emerge. These include the ability to represent one's own and others' mental states (e.g., Heider, 1958; Sperber, 2000); the emergence of social desires, among which we also count desires for the maintenance of social norms (see also, Conte and Castelfranchi, 1995); and the tendency to socially share, process, and culturally transmit huge amounts of information (e.g., Schönplflug, 2009). The social sharing, social processing, and cultural transmission of large amounts of information is, in turn, only possible because of the availability of an efficient communication medium that matches the expressive power of thought: a natural language (Pinker, 1994). Without language, society and culture, as we know it, would be inconceivable.

The social-communicative view of humans sketched above has important implications for the content and origin of their mental representations. As to *content*, it suggests that many beliefs and desires of humans are social—they concern other people's fate, actions, and mental states, as well as one's own actions towards others. Regarding *origin*, it suggests that humans acquire many, perhaps even most of their beliefs and desires through verbal communications from conspecifics. If one accepts these implications of the social-communicative view of humans, and combines them with the CBDTE model of emotion generation, it follows immediately (a) that social states of affairs should be a major class of emotion objects; and (b) that verbal communications should be a major source of emotion-relevant beliefs and desires about both social and nonsocial states of affairs (see also, Reisenzein, 2001; Rimé, 2009). Consequently, verbal communications should be humans' second main class of "emotion elicitors", in addition to sense-perceptions.

Empirical evidence supports these conclusions. For example, Reisenzein and Hofmann (1993) collected 20 descriptions of emotion-eliciting situations for each of 23 common emotions using an interview technique. A review of these descriptions for the purposes of the present article confirmed that (a) the majority of the recounted emotion-eliciting events were social in nature; and (b) the majority involved verbal communication in some form. A closer look at the issue

from the perspective of CBDTE reveals that verbal communications can influence emotion generation in at least three distinct ways.

First and most obviously, the proximate cognitive cause of an emotion—the belief that a desired or undesired event is possible or certain—is often acquired through verbal communication, rather than through any direct perception of the event. For example, Mary came to believe that Schroiber was elected chancellor (and as a consequence felt happy) when she read a newspaper headline proclaiming Schroiber's victory. Many events are in fact not directly perceivable to begin with: Events that occur on too small or too large a spatial or temporal scale, events that lie in the past, the future, or in alternative possible worlds, and events to which we lack direct epistemic access even when they are present, such as the mental states of others. Verbal communications are often our only source of information about these events, and hence the only route through which they can elicit emotions. Even if the direct perception of an event, or at least of traces or indicators of the event would be possible, we often rely on verbal communications because we lack the time or resources to make personal observations. And even when we are personal witnesses to an emotion-eliciting event, verbal communications often constitute important additional information that helps us understand what we perceive, and thereby determines what we believe. This was essentially the point of R. S. Lazarus's pioneering experiments on the effects of verbal commentaries on emotional reactions to stressful films (e.g., Lazarus and Alfert, 1964). Finally, there is one prominent class of emotion elicitors that *necessarily* involve verbal communication even when they are directly perceived; namely, verbal communications themselves. Examples are happiness about being praised for an achievement, or anger about being publicly accused of a misdemeanor. In these cases, the occurrence of the verbal communication (the speech act) is itself the object of desire or aversion, and thereby of emotion.

Second, verbal communications are important sources of the pre-existing beliefs and desires that new beliefs must match or mismatch if they are to evoke emotions. For example, prior to Schroiber's election (that caused Mary to feel happiness and surprise), Mary desired victory for Schroiber in the election, but believed that he would not win it. Mary had acquired this belief some time earlier, when a friend told her about the results of an opinion poll. Similarly, Mary came to desire Schroiber's election when she read about Schroiber's political program and concluded that it would further her life goals. When Mary later read the newspaper headline proclaiming Schroiber's election, her pre-existing belief and desire concerning Schroiber's election were automatically retrieved from long-term memory and were fed, together with the newly acquired belief that Schroiber won the election, into her emotion mechanisms, causing Mary to feel surprise and happiness. Alternatively, we may imagine that Mary acquired the belief and desire concerning Schroiber's election through direct communication from her husband Walter, Mary's expert in political matters: Walter told her that Schroiber's

election, while unlikely, would be good for the family; and Mary believed him. From the perspective of CBDTE, communications about the value (goodness or badness) of events are communications about the ability of these events to fulfill or thwart particular desires. Provided that the receivers of such a communication believe it, and share the desires that it addresses, they will acquire a new desire for the occurrence of the positively valued event, or an aversion against the negatively valued event.

Third, in addition to their ability to fairly directly (with relatively little inference) instill the beliefs and desires that proximately cause an emotion, verbal communications influence emotion generation also in a more indirect way: They are a main source of the general and specific background beliefs and desires needed to compute the beliefs and desires concerning a concrete emotion-eliciting event (Reisenzein, 2001; Reisenzein and Weber, 2009). To take a simple example, without knowledge of what a political election is, Mary could not have formed a belief concerning Schroiber's election nor a desire concerning this event; nor could she have understood verbal communications regarding Schroiber's election. A great deal, perhaps most, of this background information is transmitted verbally: By being humans' main medium of communication, language is also their main medium of cultural transmission. Considering this fact, there is perhaps no case of emotion generation in adult humans that is not to some degree influenced, at least indirectly and historically, by verbal communications. Even the fear of spiders may be culturally transmitted (see Davey, 1994).

To conclude this section, we emphasize that the verbal communications that influence emotion generation are not restricted to spontaneously occurring, unsolicited verbal messages (even though our examples featured such cases). Rather, people often actively seek out information from others in the attempt to make sense of events. In the terminology of CBDTE, the computation of the beliefs and desires that proximately cause an emotion is often a goal-directed epistemic process, that is not restricted to the person's head but extends into the social environment to include other agents as sources of knowledge, information gatherers, hypothesis testers and inference aids (Reisenzein, 2001). Indeed, in some of these cases, *most* of the work needed to compute emotion-relevant beliefs or desires is left to other agents: Physicians are consulted to determine the causes of physical complaints, detectives are hired to collect information on the partner's faithfulness, and juridical committees are installed to determine the responsibility of a defendant. Language, as humans' primary medium of communication, is what makes these social computations possible in the first place. And, as discussed in the following section, what sets the social computation process in motion is often the communication of an emotion or an emotion-eliciting event.

3.2. Using Language to Communicate Emotions and Emotion-Related Information

Just as readers of psychological works on emotion could get a one-sided view of how emotions are typically elicited, they run the risk of getting a biased view of how emotions are communicated:² Judging by the number of pages devoted to the topic of nonverbal versus verbal emotion communication, one would have to conclude that the main way in which emotions are communicated is through nonverbal signals, such as facial expressions, tone of voice, and bodily activation; whereas verbal communications (e.g., Fussell, 2002) play only a subordinate role. In contrast, CBDTE—when combined with the social-communicative view of humans sketched in the last section—predicts that language, humans’ main medium of communication, is also of central importance for the communication of emotions and emotion-related information. The theoretical rationale for this prediction will first be explained, followed by a summary of some relevant empirical research. Subsequently, we consider in more detail the predictions of CBDTE concerning what verbal reports of emotion should be like, and again summarize relevant research.

3.2.1. Emotion communication from the perspective of CBDTE

The BBC and BDC output signals with which emotions are identified in CBDTE can be viewed as *internal communications* (see also, Oatley and Johnson-Laird, 1987) of the emotion mechanisms: They inform the person about important states and actual or impending state changes in her belief-desire system, such as “a belief has just been disconfirmed by some event” or “a desire has just been fulfilled by some event”. Correspondingly, *external communications* of emotion inform others about the occurrence of a belief or desire (mis-)match in the communicating agent. Thereby, others are simultaneously alerted to two things: First, that a newly acquired belief matched or mismatched one of the person’s pre-existing beliefs or desires; and second, that something may have occurred in the world that caused at least this person to experience a belief or desire (mis-) match. For example, when Mary tells Walter “I am surprised that Schroiber was elected chancellor” she informs Walter simultaneously (a) that one of her beliefs was disconfirmed by her learning about Schroiber’s election, and (b) that something may have happened in the world (namely Schroiber’s election) that was unexpected for Mary.

2 We use the term “communication” in a broad sense, that covers intentional and unintentional, verbal and nonverbal signals transmitted between a sender and a receiver.

It is easy to see how this information—about a person’s beliefs and desires, and about the state of the world they may signify—can be useful for other people: It allows them to update their mental model of the emotion experiencer, or of the environment, and thereby to better adapt to either. In contrast, the benefits of the communication of emotion to the *sender* are not so clearly evident (e.g., Dessalles, 2007; Fridlund, 1994). On the contrary, at first sight the communication of emotion seems to cause costs to the sender: By communicating his or her emotions, the sender becomes more predictable and thus exploitable by others, and gives away useful information about the environment for free. The readiness of humans to (truthfully) communicate emotions is therefore a form of biological altruism that, like other altruistic behaviors, requires special evolutionary conditions for its emergence. Possible—not necessarily exclusive—evolutionary scenarios are kin selection, reciprocal altruism, group selection (see Richerson and Boyd, 2005), and costly signalling. With the possible exception of costly signalling (Dessalles, 2007) all of these scenarios require that emotions are not communicated indiscriminatively but *selectively* to suitable targets, be it close kin, partners in a cooperative relationship, or members of a group with which the sender identifies.

Now, for the selective communication of emotions, the verbal communication system is clearly at an advantage over the nonverbal. Nonverbal emotion communications are involuntary, natural expressions of occurrent emotions. As such, they can only indicate presently occurring emotional states of the sender. This means that, for a nonverbal emotion communication to be successful, an appropriate target must be present and paying attention at the time when the emotion occurs. If nobody is watching, the attempted emotion communication is unsuccessful; if the wrong target (e.g., an enemy) is watching, it can even be harmful (Fridlund, 1994). In contrast, verbal communications are intentional actions that deploy a symbolic representation medium that allows, in principle, the communication of whatever one is able to think of. This means, among others, that speakers can verbally communicate not only presently occurring but also past emotion episodes, and that they can precisely target their emotion communications to the right person at the right time. Thus, although Mary experiences surprise about Schroiber’s election while reading the morning newspaper, she can wait to report this emotional episode to Walter in the evening.

This advantage of verbal over nonverbal emotion communication is reinforced by a second advantage: Verbal communications allow the transmission of much more, as well as more precise, information about emotions than nonverbal signals. For all that is known, the information carried by nonverbal emotion expressions (e.g., facial expressions, physiological changes) is limited to a small number of quality and intensity distinctions (e.g., Parkinson, 2009). This is, by the way, exactly what CBDTE would predict if one assumes that nonverbal emotion communications are involuntary effects of the emotion signals—the

outputs of the belief- and desire-congruence detectors: There are only few distinct emotion signals, and they seem to be mapped only in a rough way onto the involuntary expressive systems (e.g., the facial muscles). By comparison, verbal communications about one's emotions allow one to report, at least in principle, whatever feature of emotion is available to consciousness and thus to introspection. With respect to the emotion signals themselves, it appears that both their quality and their intensity are represented in a more precise manner in consciousness, than they are reflected in nonverbal expression (Reisenzein, 2000; Reisenzein and Junge, 2011). In addition, introspection can yield information about the situational and mental context of the emotion, including the emotion's object, the beliefs and desires that caused the emotion, and the action tendencies that it may, in turn, cause (see below for further discussion). Nor are verbal communications restricted to reporting the occurrence of an emotion, or describing it; *any* thought relating to an emotion episode can be communicated, including the comparison of the emotion to remembered cases, reflections on the emotion's normative appropriateness, or recommendations on how to deal with the emotion. Of greatest significance is that verbal communication allows the emotion-eliciting event to be reported and its causes and consequences to be discussed. This advantage of verbal communication is crucial because a main evolutionary purpose of communicating emotions to others is presumably to inform them about the emotion-eliciting event (see Reisenzein, 2000, for the case of surprise).

The voluntary control over language, its expressive power, and the accessibility of emotions and their immediate mental context to introspection and thus to verbal report, point to language as the medium of choice for emotion communication in many situations. If one wants to target the communication of an emotion to a specific person at a specific time; if the emotion episode one wants to report has already occurred at some point in the past; if one wants to communicate precise information about the quality and intensity of the emotion or wants to inform others about the emotion's object or its mental and situational context; if one wants to discuss the causes and implications of the emotion-evoking event, or ways of dealing with it or with the emotion it has caused—in all these cases, one not only should, but needs to use language. The nonverbal communication of emotions seems to be mainly useful for two purposes: To accompany verbal communications about a different topic (e.g., to give immediate feedback of approval or disapproval in a cooperative discussion situation), and to convince others of the honesty of an emotion that has been communicated verbally. For example, from the perspective of CBDTE, the communication of guilt serves to inform others that the person truly cares about a social norm that she has violated (Reisenzein, 2010). It is hard to see how this communication could be achieved purely nonverbally; however, it is also plausible that a verbal

avowal of guilt will be more convincing if it is accompanied by nonverbal signs of appropriate emotion (e.g., a shaky voice or a sad face).

We cannot here examine in detail the empirical evidence relevant to these predictions; however, by and large, it seems to be supportive. In particular, studies on the social sharing of emotions suggest that information about emotions and the events that elicit them are regularly communicated verbally to others, but in a selective fashion: The targets are mainly close relatives, partners, and friends (Rimé, 2009). In contrast, occurrent emotions are frequently *not* revealed in facial expressions or bodily changes (e.g., Mauss, Wilhelm and Gross, 2004; Reisenzein, Bördgen, Holtbernd and Matz, 2006; Russell and Bachorowski, 2003). In line with our predictions, nonverbal expressions of emotion seem to occur only under special circumstances, with the social context (the presence of others, especially friends) again playing a particularly important role (Wagner and Lee, 1999).

3.2.2. Verbal reports of emotion from the perspective of CBDTE

If CBDTE is a correct description of the emotion system, one should expect introspective reports of emotion to recognizably reflect the operation of the emotion mechanisms posited by the theory. According to CBDTE, emotions are (normally) conscious experiences similar to sensations that arise when newly acquired beliefs are detected by the emotion mechanisms to be congruent or incongruent with existing beliefs or desires. Presupposing the introspectability of the inputs and outputs of the emotion mechanisms³ and the availability of appropriate concepts in the language of thought, CBDTE therefore predicts that people undergoing an emotion can, via introspection, acquire the belief (a) that they experience one of a small set of distinct feelings (e.g., pleasure or surprise) with a particular intensity, (b) that commenced when they came to believe that a certain state of affairs was certain or possible (c) that they wanted or did not want, and/or had expected or not expected to occur. Furthermore, (d) the emotional feeling should appear to them to be directed at this state of affairs (Reisenzein, 2009a).

To be able to report such mental occurrences, a speaker needs at the minimum natural language words for the inputs and outputs of the emotion mechanisms—words for belief, desire, and the basic kinds of emotional feeling (in particular pleasure, displeasure and surprise). Actually, provided that a generic term for feeling is available, even words for specific feelings are dispensable, for

3 Although few would deny that conscious beliefs and emotional feelings are available to introspection, it can be debated whether desires are similarly directly introspectable (Fernández, 2007).

one can always say “I feel as one does when...” followed by a description of the particular constellation of inputs to the emotion mechanisms that causes the feeling in question. For example, in the case of fear, one can say “I feel as one does when one believes something could happen that one does not want to happen” (cf. Wierzbicka, 1999). If the speakers of a language want to enlarge their emotion vocabulary beyond these “semantic primitives” (Wierzbicka, 1999), they could next add words that denote the basic kinds of output (i.e., the emotion signals, or feelings) of the BBC and BDC resulting from basic input constellations; such as “happiness” = “the feeling one has when one believes that something one desires is the case”; “surprise” = “the feeling one has when one believes that something unexpected is the case”, and “disappointment” = “the feeling one has when one believes that something one desires and expected is not the case”. However, note that CBDTE also allows speakers to create words for more complex emotions, such as guilt (Hupka et al., 1999), directly from the semantic primitives.

Linguistic communities create words for things they want to talk about. Given the apparently universal need to talk about emotions (Rimé, 2009), CBDTE therefore predicts: (a) all languages contain at least the minimum vocabulary necessary to describe emotions (terms denoting belief, desire, and feeling); (b) if a language additionally contains words for specific (“propositional”) emotions, these words have a belief-desire analysis. Again, these predictions seem to be in line with the evidence. First, it is not only English or German but all languages that seem to have words for belief, desire, and feeling—the building blocks of the “definitions” of emotion words (Wierzbicka, 1999; 2009a). According to Wierzbicka, these semantic primitives belong to a vocabulary of 63 basic terms that are common to all languages and may reflect (i.e., may be the natural language equivalents of) the innate part of the vocabulary of the language of thought (Wierzbicka, 2009b). Second, as far as can be said, words for “propositional” emotions in different languages do indeed have a belief-desire analysis (Wierzbicka, 1999; 2009a; see also the research on the acquisition of emotion concepts in children; e.g., Wellmann, 2002; Doherty, 2009).⁴ In contrast, alternative proposed semantic analyses of the emotion lexicon that assume a different set of primitives—typically, words for “discrete basic emotions” such as happiness, sadness, fear, anger and disgust (e.g., Ekman, 1992; Johnson-Laird and Oatley, 1989)—have at best met with limited success (see e.g., Reisenzein, 1995; Wierzbicka, 1999; and Chapter 5 in Meyer, Schützwohl and Reisenzein, 2001).

4 Wierzbicka’s (2009a) most recent list of 63 universal concepts does not include “belief”; it does, however, include “know” and “think”, which seem close enough. In addition, Wierzbicka’s list includes the terms “good” and “bad”, as well as intensity modifiers (“very”, “more”), both of which can be used for a more precise description of emotional feelings.

It might be argued that this confirmation of the predictions of CBDTE by linguistic data is not surprising, given that the belief-desire theory of emotion on which CBDTE is based is itself an explication of the common-sense psychology of emotion implicit in language. Even so, the fact that different attempts (by philosophers, psychologists, and linguists) to explicate the common-sense psychology of emotion converge on a belief-desire analysis *is* an important piece of support for CBDTE. Furthermore, Wierzbicka's (1999; 2009a) crosscultural analyses of the emotion lexicon suggest that a belief-desire analysis of emotion words is possible for *all* languages. CBDTE can explain how this intercultural agreement comes about: (a) All humans have innate, hardwired emotion mechanisms that operate on propositional mental representations and produce distinctive experiential outputs. (b) All humans have the capacity to become introspectively aware of the inputs and outputs of the emotion mechanisms (by forming beliefs about them using the language of thought). (c) Humans everywhere seem to have a need to communicate their emotions to others, at least under certain circumstances; this leads to the creation of natural language emotion words. (d) Due to the way the emotion mechanisms are constituted, these words have a belief-desire analysis. In addition, CBDTE provides an explanation of the intercultural (e.g., Hupka et al., 1999; Russell, 1991) as well as the interindividual (e.g., Reisenzein and Hofmann, 1993; Wallace and Carson, 1973) differences in the emotion lexicon (as far as they concern "propositional" emotions). At least three factors seem to be responsible for these differences. First, the mapping of mental states into language is not exact, and can be done in more than one way.⁵ Second, the size of any special vocabulary, and hence also of the vocabulary of emotion, increases with the size of the linguistic community. Third, some kinds of emotion (e.g., guilt, shame, or fear) seem to be regarded as more important in some cultures than in others; therefore, more words are created for them and their subforms (e.g., Hupka et al., 1999; Russell, 1991).

To conclude our discussion of the relationship between emotion and natural language, we would like to point out that the roles that have been claimed for language in the generation and communication of emotions *in everyday life* are paralleled by analogous roles of language in *emotion research*. Verbal communications (from the experimenter or a confederate) are an indispensable ingredient, if not the central means, of most methods used to induce (propositional) emotions in the laboratory (Studtmann, Otto and Reisenzein, 2009). Verbal self-reports of emotion, typically in the form of ratings on scales, are the most-used method of assessing emotions in psychological research (e.g., Scherer, 2005). And in science as in everyday life, language is the central means

5 Hence, the emotion terms that appear in CBDTE are actually *theoretical definitions* meant to refine and clarify the nature of the emotional states described by ordinary language emotion words (see also, Castelfranchi and Miceli, 2009; Ortony et al., 1988; Reisenzein, 2007).

used to communicate about and discuss emotions. In addition, the common-sense psychology of emotion implicit in language imposes, in our view, important constraints on theories of emotion. At minimum, language demarcates, if only in a rough way, the set of phenomena that emotion theory needs to explain: These are the phenomena denoted by ordinary language emotion words (Reisenzein, 2007).

4. Why Emotions Require a Language of Thought

According to CBDTE, emotions are the results of computations in a propositional representation system, a language of thought. We emphasize that this assumption is not meant to deny the existence of nonpropositional mental representation systems, such as sensory, imagistic, or motor codes (e.g., Anderson and Lebiere, 1998; Power and Dalgleish, 1997). In fact, the assumption of CBDTE that emotions are nonconceptual, sensation-like representations *implies* the existence of at least one non-linguistic mental code—a sensory code reserved for affect. What is more, CBDTE not only allows, but positively suggests, that some kinds of affective experiences in the broad sense, such as the pleasures and displeasures caused by simple sensations (e.g., the pleasure caused by the smell of a rose; Reisenzein, 2006), are based on nonpropositional mental representations. However, CBDTE insists that a language of thought is required for emotions that are directed at propositional objects (states of affairs). More generally, CBDTE subscribes to a cognitive architecture in which a propositional representation system occupies a central role: It serves to conceptually interpret and to integrate the outputs of nonconceptual (specifically sensory) modules; it enables systematic thought (inference) and the strategic control of action (e.g., Anderson and Lebiere, 1998; Fodor, 1975; Kintsch, 1988); and, we submit, it underlies emotional reactions to believed and imagined states of affairs.

Many arguments have been put forward for the assumption that the “central code” is linguistic (see e.g., Aydede, 2004; Fodor, 1975; 1987; Kaye, 1995; Schneider, 2009). We already mentioned one central argument, that was also a decisive motive for the representational assumptions of CBDTE: In contrast to other proposed mental representation systems (e.g., imagistic codes, distributed neural network representations), a language of thought provides a natural computational explication of propositional attitudes and thereby holds the most promise for the naturalization of common-sense psychology, parts of which are explicated in BDTE.

A second argument (actually a whole set of arguments) for the existence of a language of thought appeals to salient features of thought that any theory of mental representation needs to explain. These features include the productivity of thought (the ability to form an unlimited number of thoughts), the compositional structure and systematicity of thought contents, their complexity, and their

informational selectivity (see e.g., Aydede, 2004; Fodor, 1987; Fodor and Pylyshyn, 1988; Jacob, 1997; Kaye, 1995). Although these arguments have not been formulated specifically for emotions, but for “thoughts” (a generic term for propositional attitudes), their extension to emotions is straightforward. To illustrate, consider the argument from complexity (Kaye, 1995). Formulated for emotions, the argument is that only a language-like representation system is able to represent the potentially highly complex objects of the emotions covered by CBDTE (in CBDTE, these are the objects of the beliefs that proximately cause emotions). In our standard example, Mary was happy *that Schroiber won the election*. But just as easily, Mary could have been happy *that Peter was happy that Schroiber won the election*, or *that Peter realized that she had always wanted Schroiber to win*. Whereas a language of thought handles such complex, hierarchically nested propositional contents quite naturally, it is at best uncertain whether other proposed mental representation systems can handle them. For example, consider imagistic (image-like) representations. As traditionally conceived of, imagistic representations are simply not suited to represent propositional contents (e.g., Fodor, 1975). And although more recently proposed imagistic representation systems—specifically the perceptual symbol systems described in Barsalou (1999)—are to some extent able to handle propositions (though see Machery, 2006), it appears that this is so precisely because they incorporate crucial features of propositional representation systems. Indeed, it seems to us that a perceptual symbol system that is able to represent propositions of arbitrary complexity is essentially just a propositional representation system with a partly iconic symbol set (i.e., a subset of the symbols resemble what they represent). The availability of iconic symbols in a language of thought may have certain advantages; for example, it may increase the representational capacity of the internal code, or help to solve the symbol-grounding problem. However, such a representation system is a language of thought all the same (see already Fodor, 1975).

Yet another powerful argument for why emotions require a propositional representation system is provided by considering the important role of natural language in the generation and communication of emotions. Obviously, verbally communicated information already comes in a propositional format—that of sentences in a natural language. To be able to mentally represent the verbally communicated information and to integrate it with nonverbal information acquired through direct sense-perception, the expressive power of the mental code used for these purposes must be no less than that of the natural language in which the verbal message is formulated. This consideration suggests, once again, that the internal representation system that supports emotions is propositional, and that its expressive power matches that of a natural language (see also, Siemer and Reisenzein, 2007).

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