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CHAPTER 8

The Role of Appraisal in Emotion

Agnes Moors and Klaus R. Scherer

The idea that appraisal plays a role in emotion can be traced back to Aristotle, Descartes, Spinoza, and Hume, who considered it self-evident that the states variously called *passions, affects*, or *emotions* are differentiated by the type of evaluation or judgment a person makes of the eliciting event. This shared conviction was shattered by James's (1884/1969) claim that "the bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur *is* the emotion" (p. 247). Although James meant *feeling* when he wrote *emotion* and later acknowledged that the nature of the bodily changes was determined by the overwhelming "idea" of the significance of a situation for well-being (e.g., the probability that the bear will kill us or that we will kill it; James, 1894, p. 518), a century of debate and misunderstanding was launched (Ellsworth, 1994). Appraisal did not play much of a role in this debate nor did it in the (biological versions of) basic emotion theories, pioneered by Tomkins (1962) and his disciples Ekman (1972) and Izard (1977), which dominated the emotion domain from the 1960s to the 1980s.

The term *appraisal* was first used in a technical sense by Arnold (1960) and Lazarus (1966). Detailed development of this notion only occurred in the early 1980s (Scherer, 1999; Schorr, 2001), leading to what is now referred to as *appraisal theories*. Theorists in this tradition propose that most, but not all, emotions are elicited and differentiated by people's evaluation of the significance of events for their well-being (Ellsworth & Scherer, 2003). Currently, many contemporary emotion theories mention appraisal. For instance, Ekman (2004, pp. 121–126) postulated "automatic appraisal mechanisms" as triggers of emotion. Feldman Barrett (2006) suggested that appraisal can play a role in the generation of core affect, and Russell (2003) suggested that appraisal may be one of several independent components of an emotion episode. Yet, not all theories that mention appraisal qualify as appraisal theories. In the present chapter, we propose two related criteria for a theory to count as an appraisal theory: (1) Appraisal theories consider appraisal as a typical cause of emotion (or of emotional components), and because of this, (2) appraisal is the core determinant of the content of feelings. Before addressing the relation between appraisal and emotion, we consider definitions of the terms *emotion* and *appraisal*. This is crucial because the definitions that one has of these concepts determine in part how one thinks of the relation between them. In addition to commonalities among appraisal theories, we also highlight their differences.

Definition of Emotion

The lack of an agreed-upon definition of the term *emotion* has led to serious misunderstandings. We need to briefly address this issue and mark our position. The set of emotions can be defined with an intensional definition. Such a definition lists the necessary and sufficient conditions or criteria for an emotion exemplar to belong to the set, and they demarcate the set from particular other sets such as moods, attitudes, reflexes, and personality traits. A first set of criteria that often turns up in the literature has to do with duration. Emotion theorists agree that emotions are episodes (i.e., phenomena with a beginning and an end) and not enduring states. Although these episodes vary in duration, they are usually short-lived. These criteria serve to distinguish emotions from personality traits and moods.

A second set of criteria is that emotions consist of multiple components, or better, changes in multiple components. Many theorists include a cognitive component, a motivational one, a somatic one, a motor one, and a subjective one. Components (or parts of them) have been linked to functions. The cognitive component consists of an appraisal process, whose function is to evaluate the implications of stimuli for well-being. The motivational component consists of action tendencies (e.g., to increase contact) and other forms of action readiness (e.g., passivity). The somatic component consists of physiological activity, both central (in the brain) and peripheral (outside the brain). The motivational and somatic components have the function to prepare and support behavior. In fact, the central part of the somatic component supports all components. The motor component consists of facial and vocal expressions and gross behavior (e.g., fleeing, fighting, repairing) and has the function to execute behavior. Finally, the subjective component consists of experience or feelings, and has been endowed with a monitoring function (and other functions associated with consciousness). Theorists differ in how many and which of these components (or parts of components) they require to be present and whether these need to be synchronized, in order to talk about an emotion. For instance, some authors (e.g., Mulligan & Scherer, 2012; Scherer, 1984) exclude gross behavior, considering it as a consequence of emotion. Some authors (e.g., Parrott, 2007) exclude central somatic activity because it is present, on a lower level of analysis, in all the other components. Some authors (e.g., Clore & Ortony, 2000) have added other cognitive processes in addition to appraisal, such as changes in attention and memory, and categorization and labeling of one's emotion. The presence of certain components serves to differentiate emotions from other phenomena, such as attitudes or preferences (these are said to lack the somatic and motor components) and reflexes (these are said to lack a cognitive component).

A third set of criteria involves the content or the properties of certain components. Appraisal theorists have argued that emotions occur when stimuli are appraised as goal relevant, goal congruent/incongruent, positive/negative, and novel and/or urgent (Frijda, 1986; Scherer, 2005). Some theorists (Ortony & Turner, 1990) have argued that the feeling component of emotions must have a positive or negative valence (excluding surprise and interest from the set of emotions). Others (Frijda, 2007) have argued that the action tendencies in emotions have control precedence: They demand priority over other action tendencies. A fourth criterion proposed by Scherer (2001, 2009) is that emotions are, more than other phenomena, characterized by a high degree of integration and synchronization among all components. A fifth criterion emphasized by philosophers (e.g., de Sousa, 1987; Solomon, 1984) is that emotions have the property of intentionality (in the philosophical sense of the term). This means that they are directed toward something beyond themselves, that they have an object (e.g., being angry at someone, or being afraid of something). This criterion differentiates emotions from purely physical sensations (e.g., pain) that are not about something.

Definition of Appraisal

Since Arnold (1960) first used the term *appraisal* in the context of emotion, there has been an evolution in the way in which theorists have used it. We therefore think it is important to present and justify our own

definition of appraisal, which is neither limited to higher-order cognitive processes, nor overinclusive (to refute the most frequent criticisms of appraisal theories). The singular use (appraisal) refers to the appraisal process and the plural use (appraisals) to the values that form the output of this process. We discuss both below.

Appraisal Process

To arrive at an intensional definition of the appraisal process, we rely on Marr's (1982) proposal that any process can be described at three levels of analysis. At the functional level, a process is described as the relation between an input and an output. For example, the process of adding digits can be described as the relation between two digits and their sum. The conditions under which the process takes place, such as the presence or absence of consciousness, processing goals, attentional capacity, and time, can also be specified at this level. At the algorithmic level, the mechanisms and format of the representations (i.e., codes) that are involved in translating the input into the output are specified. Adding digits can be done by a rule-based process, such as counting the units in both digits, or it can be done by an associative process, that is, by retrieving a previously calculated and stored sum. The format of the representations can be verbal-like versus image-like and localist versus distributed. At the implementational level, the process is described in terms of areas or circuits of brain activity.

We propose an intensional definition of appraisal at the functional level (cf. Moors, 2010). That is, we demarcate the appraisal process from other processes on the basis of the content of its input and/or output. The appraisal process takes a stimulus (as its input) and produces (as its output) values for one or more appraisal factors (e.g., goal relevance, goal congruence, coping potential, expectancy). This definition is not all-inclusive. It does not include processes that produce a value for other factors than appraisal factors (e.g., size, length, gender, location, color).

A first implication of defining appraisal in terms of input and/or output is that appraisal is not confined to operate under a specific set of conditions. Appraisal theorists have argued from the very start (e.g., Arnold, 1960) that appraisal can and often does operate automatically. This means that it can operate in the absence of a conscious stimulus input, the absence of a goal to engage in the process, the absence of abundant attentional capacity, the absence of abundant time, and/or despite the presence of a goal to counteract the process.

A second implication of defining appraisal on the functional level is that we do not confine appraisal to one single mechanism or to one format of representations on the algorithmic level. Any mechanism that produces values for one or more appraisal factors is accepted as a valid mechanism underlying appraisal. Appraisal theorists have proposed two or three possible mechanisms: a rule-based mechanism, an associative mechanism, and sometimes also a sensory–motor mechanism (Clore & Ortony, 2000, 2008; Leventhal & Scherer, 1987; Smith & Kirby, 2000, 2001; Smith & Neumann, 2005; van Reekum & Scherer, 1997). The mechanisms may use and produce any possible format of representations. Representations can be verbal-like (propositional or conceptual) or image-like (perceptual or sensory). They can be localist and symbolic (one node refers to an appraisal value) or they can be distributed and subsymbolic (one appraisal value is represented as a pattern of activation over a set of nodes).

In sum, our intensional definition of appraisal at the functional level makes it clear that appraisal should not be narrowed down to a nonautomatic, rule-based mechanism that operates on verbal-like or symbolic codes, as is still too often assumed by critics of appraisal theories. Despite the fact that we allow the entire range of mechanisms and formats of representation to underlie appraisal and that we do not put a priori constraints on the conditions under which appraisal can operate, our definition of appraisal is not all-inclusive. This is because we reserve the term *appraisal* for only those processes that deal with specific types of information captured in the appraisal factors proposed by appraisal theories. Determining which factors do or do not qualify as real appraisal factors is a work in progress. At this point, the existing proposals can be considered as working hypotheses that require further empirical research.

Individual appraisal theorists agree about a core set of appraisal factors—goal relevance, goal congruence, expectancy or novelty, coping potential or control, agency, and intentionality—but they disagree about others, such as intrinsic valence (see Table 29.1 in Ellsworth & Scherer, 2003). Appraisal factors can be treated as categorical variables, with a discrete number of possible values (two or three), or as dimensional variables, with an infinite number of possible values. For example, in a categorical account, the factor *goal congruence* (i.e., whether a stimulus matches with goals or concerns) has two values (goal congruent, goal incongruent), whereas in the dimensional account, it has an infinite number of values ranging from totally goal incongruent to totally goal congruent. Some factors are necessarily categorical. For instance, agency (i.e., the cause of an event) has values such as self, other, and impersonal circumstances. Identifying a list of typical appraisal factors fits in a molecular approach toward appraisal. Lazarus and his collaborators (e.g., Lazarus, 1991; Smith & Lazarus, 1993) combined the molecular approach with a molar one. In a molar approach, appraisal is treated as a unitary factor with a number of discrete values such as danger, insult, and irrevocable loss ("core relational themes"). These molar values are often considered as summaries or gestalts of molecular values (Smith & Lazarus, 1993, p. 236).

Appraisal Output

As mentioned, the output of the appraisal process is a representation of one or more appraisal values (i.e., *appraisals*) that have specific effects on other components (motivational, somatic, motor, feeling). There are no a priori constraints on the format of this representation or the conditions under which it can exist. Representations of appraisal values are unconscious by default, but part of their content can become conscious. The part that does become conscious becomes part of the content of the feeling component (based on the idea that feelings are the reflection of the other components into consciousness; see below). Only part of this conscious part is available for verbal report (see Scherer, 2009).

Relations between Appraisal and Emotion or the Other Components

Emotion theorists have proposed various kinds of relations between appraisal and emotion or the other components of emotion (Ellsworth & Scherer, 2003; Frijda, 1993, 2007; Keltner, Ellsworth, & Edwards, 1993; Parkinson, 1997; Scherer, 2001, 2009). They have argued that appraisal (1) is a component of emotion (part–whole relation), (2) is a cause of the other components (causal relation), (3) is part of the content of the feeling component, (4) is a consequence of the other components (causal relation), (5) temporally co-occurs with the other components (contiguity relation), and (6) is part of the meaning of emotion labels (conceptual relation). We discuss each of these relations as well as the extent to which they are mutually compatible.

Appraisal as a Component of Emotion

In our componential definition of emotion, we presented appraisal as one of the components in an emotion. Appraisal in this sense is fairly uncontroversial (Frijda, 2007), but there may be disagreement about the proportion of emotions in which appraisal is a component. Theorists may think that appraisal is a component in (1) all, (2) most, or (3) some emotions. In other words, theorists may think that appraisal is a (1) necessary, (2) typical, or (3) occasional component of emotion. Most appraisal theorists side with the view that appraisal is a typical or even necessary component of emotion.

Appraisal as a Cause of the Other Components

Several appraisal theorists think that appraisal is not just a component of the emotion episode. They think it is also a cause of the other components. This means that appraisal comes first in the causal chain and that it drives the changes in action tendencies, physiological responses, expressive behavior, and feelings (see Figure 8.1 for an example of this approach). The word *first* should be nuanced because contemporary appraisal theorists build in the notions of recurrence and immediate efference. *Recurrence* means

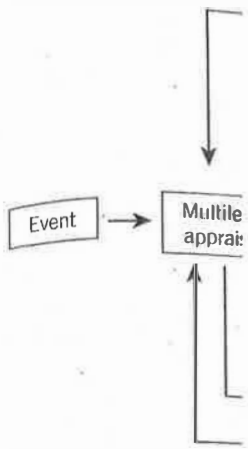


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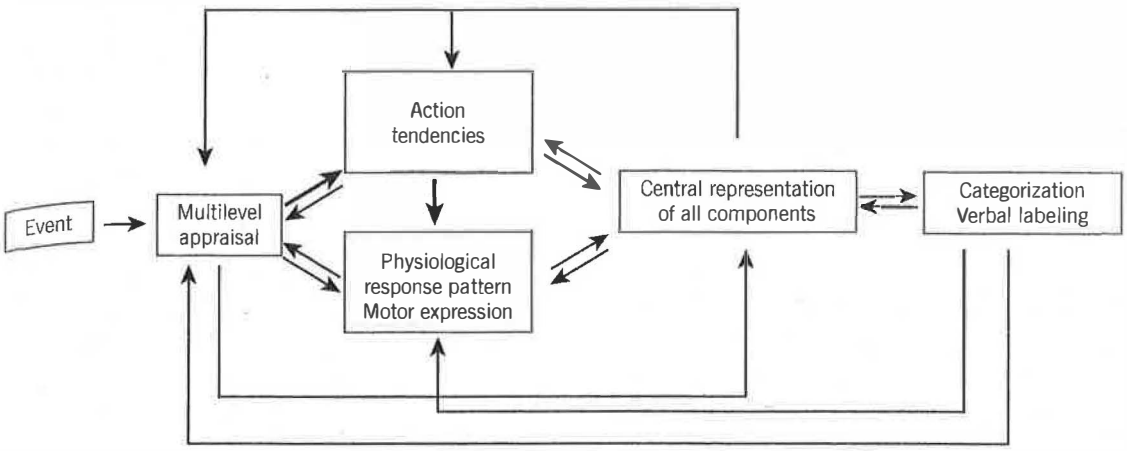


FIGURE 8.1. The causal, recursive relationship between emotion components, as suggested by the component process model. Adapted from Scherer (2009). Copyright 2009 by Taylor and Francis. Adapted by permission.

that changes in later components feed back to earlier components. Somatic and behavioral responses may produce a change of appraisal, either directly or indirectly (via a change in the stimulus). For example, an aggressive response may lead to an appraisal of high coping potential by making the person stronger (i.e., direct influence) or by making the opponent weaker (i.e., indirect influence). Because of recurrence, several emotional cycles may run in parallel. This is not incompatible with the idea that appraisal comes first, as long as appraisal comes first in each cycle. *Immediate efference* refers to the idea that the processes in early components can influence later components before they are entirely completed. Processes that are partially completed can influence other processes once they have produced a preliminary output.

Some theorists think appraisal causes the other components in all instances of emotions; they see appraisal as a necessary cause (e.g., Lazarus, 1991). Others think that appraisal causes the other components in most, but not all, instances of emotions; they see appraisal as a typical cause (e.g., Ellsworth & Scherer, 2003). This brings us to the first criterion that we propose for delineating the set of appraisal theories from other emotion theories: Appraisal theories consider appraisal to be at least a typical cause of the other components in emotions.

Appraisal as Part of the Content of the Feeling Component

Once a stimulus has produced changes in the components of appraisal, action tendencies, physiological responses, and behavior, an integrated representation of aspects of these changes surfaces into consciousness. Conscious aspects of appraisal are integrated with the representation of changes from other components (e.g., viscera-motor proprioception) and together they shape the content of the feeling component. What types of aspects contribute to the content of feelings? In the case of the appraisal component, Lambie and Marcel (2002) have argued that not the appraisal process itself but (part of) the output of the appraisal process surfaces into feelings. As explained above, the appraisal process produces an appraisal output, which is a representation of appraisal values. This representation is generally unconscious, but part of it can become conscious and hence contribute to the content of feelings. It may be noted, however, that the distinction between process and output is not so clear-cut when a process is considered on the functional level of analysis, that is, as the relation between an input and an output. Thus, it is possible that individuals are conscious of (1) the input (i.e., the stimulus), (2) the output of appraisal (i.e., appraisal values), and (3) the appraisal processes described on a func-

tional level of analysis, as a relation between input and output (e.g., that a stimulus was appraised as goal incongruent and difficult to cope with). It is highly unlikely, however, that individuals have conscious access to processes described on the algorithmic or implementational levels of analysis (Moors & De Houwer, 2006).

As mentioned above, the content of feelings is not only determined by appraisal but also by the other components in the emotion episode. As a consequence, the relation between appraisal and feelings is not linear. Aspects of the appraisal component may blend in with the other components so that it is difficult to disentangle the aspects that come from appraisal and those that come from the other components. For example, when a person feels strong, this feeling may stem from an appraisal of high coping potential (appraisal component) or from the tendency to destroy (motivational component). Disentangling the sources of feelings is further complicated by possible causal influences among components. An appraisal of high coping potential may cause the tendency to fight (conform to the idea that appraisal causes the other components). Turning it around, the tendency to fight may cause a person to appraise his or her coping potential as high (conform to the idea of recurrence).

Individual components may differ with regard to the ease with which they are consciously accessed. It is important to keep in mind, however, that conscious access is not identical to ease of self-report. Some components (e.g., peripheral part of the somatic component) may be easy to feel but difficult to put into words.

If one accepts that appraisal is a component of emotion and that aspects of all components are integrated and reflected in the content of the feeling component, it clearly follows that appraisal determines part of the content of the feeling component. If one accepts that appraisal is also a cause of the other components (motivational, somatic, motor), it also determines the content of the feeling component via its influence on the other components. In that case, appraisal is not a minor contributing factor, but the core determinant of feelings. This is the second criterion that we propose for delineating appraisal theories from other emotion theories. Appraisal theorists think of appraisal as the core determinant of feelings, at least in most emotion episodes, due to its direct and indirect impact. It may be noted that the notion of appraisal as part of the content of feelings is compatible but not redundant with the notion of appraisal as a component of emotion. This is because only part of appraisal is reflected in consciousness.

Appraisal as a Consequence of the Other Components

Some theorists have emphasized the role of appraisal as a consequence of emotion (or of the other components). For example, Berkowitz (1990; Berkowitz & Harmon-Jones, 2004) has argued that an appraisal of agency and/or intentionality may occur as a consequence of a feeling of anger. Anger encourages people to search for someone to blame (an intentional agent). Here too, there can be different opinions about whether appraisal is a consequence in all, most, or only some emotion episodes.

Theorists (e.g., Berkowitz, 1990) who emphasize the role of appraisal as a consequence of emotion have often treated it as an alternative to the role of appraisal as a cause of emotion. Yet, the roles of cause and consequence are not incompatible, as long as two separate appraisal processes are involved (or two phases in the same appraisal process). In a first step, one appraisal process (or phase) may cause the other components. In a second step, the other components may cause a new appraisal process (or phase) corresponding to what we called *recurrence*. Saying that appraisal is more often a consequence than a cause of emotion amounts to saying that the second step occurs more often than the first step. Several appraisal theorists have acknowledged that the first step often consists of a rudimentary form of appraisal (involving only the simplest appraisal factors or mechanisms), whereas the second step gives rise to a more complex form of appraisal (involving more sophisticated appraisal factors or mechanisms; Frijda, 1993). Even in these cases, appraisal does act as a cause and as a consequence of the other components.

Appraisal as Merely Temporally Co-Occurring with Other Components

All the relations discussed so far imply that appraisal occurs in close temporal proximity (i.e., before, after, or simultaneously) with the other components. For the sake of completeness, we mention the possibility that appraisal occurs in close temporal proximity with the other components without there being any causal relations among the components. In theory, appraisal can precede the other components without causing them and it can follow the other components without being caused by them. Even theorists who exclude appraisal as a component of emotion may still accept temporal co-occurrence between appraisal and the other components.

Appraisal as Part of the Meaning of Emotion Labels

Several authors (Frijda, 1993; Frijda & Zeelenberg, 2001; Parkinson, 1997) have drawn attention to the fact that appraisal and emotion are conceptually related. Appraisal values are part of the meaning of vernacular emotion labels. For example, danger is part of fear, loss is part of sadness, and high coping potential and other-agency are part of anger. Once a person establishes a relation between two concepts, it becomes a sort of knowledge. This knowledge may or may not be activated during an emotional episode, and it may or may not have an influence on the other components. This knowledge may also be activated outside an emotion episode. The conceptual relation between appraisal and emotion may stem originally from any of the relations between appraisal and emotion described above (part–whole, causal, temporal co-occurrence), but it may also have other sources (e.g., culturally transmitted stereotypic schemas). Hence, knowledge about appraisals and emotions may reflect the actual co-occurrence of appraisals and emotions at some point in time or it may reflect an imagined co-occurrence. Like the other relations described above, the conceptual relation between appraisal and emotion may be considered as being necessary, typical, or occasional (Parkinson, 1997).

Starting from the idea that the meaning of emotion words can be exhaustively described by profile values on all components (Scherer, 2005, pp. 709–712), Fontaine, Scherer, and Soriano (in press) conducted an intercultural and cross-linguistic study involving 35 datasets from 27 countries covering a total of 24 different languages. For 24 emotion words native speakers indicated the probability with which 144 features, representing all components, would apply to a person described as experiencing the respective emotion. Multiple discriminant analyses revealed that 31 appraisal features allowed the correct classification of 71% of the cases (after cross-validation). Adding features of the other components led to relatively small increases of the accuracy percentage: 40 action tendency features increased it to 75.4%, 18 bodily sensations and 26 motor expression features increased it to 80.9%, and 22 feeling features added nothing. The fact that appraisal explains the lion's share of the variance and that all other components explain a relatively small share aligns with appraisal theories' claim that appraisal drives changes in the other components.

To summarize, appraisal theories and other emotion theories attribute several roles to appraisal. We have put forward two criteria to demarcate appraisal theories from other theories: Appraisal theories argue that appraisal is a typical cause of the other components in emotions, and because of this, they argue that appraisal is the core determinant of the content of feelings. In the next section, we explore the first criterion (that appraisal is a typical cause of the other components) in further detail, using illustrations from causal appraisal theories. After that, we identify the kinds of evidence that would be needed to support the causal claim, and we review some of the existing empirical evidence. Given that the second claim (that appraisal is the core determinant of feelings) follows from the first claim, finding evidence for the first claim is essential for the second claim as well.

Exploration of the Causal Claim

The causal chain from stimulus to emotion can be split into two steps. The first step deals with the stimulus. In the second step, the output of the first step is translated into

an emotion or the other emotional components. Appraisal theories have addressed both steps in the causal chain. The appraisal process takes place in the first step. Translation of the appraisal values into emotions or values of the other components takes place in the second step. The processes occurring in each of these steps can be considered at each of the three levels of analysis (functional, algorithmic, and implementational). In this chapter, we consider hypotheses about the functional level, the algorithmic level, and the relation between the two levels. So far, there has been little systematic work on the implementational level for appraisal and its relation to the other levels (but see Sander, Grandjean, & Scherer, 2005; Scherer & Peper, 2001).

Emotion Causation at the Functional Level

At the functional level of analysis, appraisal theories propose hypotheses about the appraisal factors that are processed (first step) and about links between appraisal values and specific emotions or values of the other components (second step). Hypotheses about the first step are related to those about the second step because it is implicitly assumed that only those appraisal factors are processed (first step) that play a role in the causation of emotions or their components (second step). Hypotheses about the second step take appraisal values as the independent variables. These values may be of the molar (e.g., danger, loss, and insult) or the molecular kind (e.g., goal congruent, high coping potential, and other agency). The dependent variables can be the occurrence, the intensity, and the quality of (1) an emotion or of (2) each of the other components (action tendencies, somatic responses, motor responses, and/or feelings). Actually, each of these components can be treated in a molar or a molecular way (see Table 8.1).

Many appraisal theories propose hypotheses about links between molecular appraisal values and entire emotions. For example, they predict that a pattern consisting of the molecular appraisal values of goal incongruent, high coping potential, and other-agency leads to anger (Ellsworth & Scherer, 2003). Other appraisal theories have hypothesized links between molecular appraisal values and the molar values of the other components. For instance, some theorists predict that a pattern consisting of the appraisal values of goal incongruent, high coping potential, and other-agency leads to the tendency to attack. Few appraisal theorists hypothesize links between molecular appraisal values and molecular values of other components. Roseman (2001), for example, predicts that goal congruence leads to action tendencies characterized by approach, and that low coping potential leads to action tendencies characterized by adjustment of the self to the environment. Scherer (2001, 2009) and Smith (1989) predict (and investigate) links between molecular appraisal values and molecular values of facial and vocal expressions and physiological responses (see Table 8.2 for examples).

Emotion Causation at the Algorithmic Level

Appraisal theories have developed hypotheses about mechanisms and the format of the representations involved in (1) appraisal (first step) and in (2) the translation of appraisal values into emotions or values of the other components (second step). In addition, some appraisal theories (e.g., Scherer, 2009) present hypotheses about how to span the bridge between the functional and algorithmic levels.

With regard to the first step, most appraisal theorists adopt a dual- or triple-mode model, accepting rule-based, associative, and/or sensory–motor mechanisms as ones underlying appraisal. In a rule-based mechanism, a rule is applied to a stimulus and computation of the rule produces an appraisal value. These values may or may not be integrated in a pattern. The associative mechanism is sometimes described as the spreading of activation from the representation of the stimulus to a representation of a pattern of appraisal values, but not many appraisal theories have detailed hypotheses about the structure of the associations and the format of the representations involved. As in other research domains in which a dual- or triple-mode view is endorsed, it is often assumed that the rule-based mechanism operates on verbal-like representations and that it is flexible but nonautomatic, whereas the associative and sensory–motor mechanisms are

TABLE 8.1. Exampl

Appraisal
Action tendencies
Peripheral physiologic responses
Central physiological responses
Facial expressions
Vocal expressions
Gross behavior
Feelings

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TABLE 8.1. Examples of Molar and Molecular Values for (Sub)components of Emotions

	Molar values	Molecular factors + values
Appraisal	Danger Irrevocable loss Demeaning offense	Goal congruence: congruent/incongruent Coping potential: low/high Agency: self/other/circumstances
Action tendencies	Tendency to fight Tendency to flee Tendency to give in	Level of activity: active versus passive Direction of movement: toward versus away from stimulus Direction of fit: fit stimulus to self versus fit self to stimulus Target: self versus not self
Peripheral physiological responses	Boiling Shivering Blushing	Heart rate Blood pressure Galvanic skin response Muscle tension
Central physiological responses	No examples	Activity in amygdala Activity in prefrontal cortex
Facial expressions	Smiling face Scowling face Fearful face Sad face	Facial activity in terms of: Action units: mouth corners pulled up, inner eyebrows raised, nose wrinkle Face muscles: zygomaticus major, orbicularis occuli, corrugator supercilii
Vocal expressions	Screaming Laughter	Pitch Tempo Rhythm Pausing Loudness Frequency perturbations
Gross behavior	Fleeing Fighting Protecting Repairing	Level of activity: active versus passive Direction of movement: toward versus away from stimulus Direction of fit: fit stimulus to self versus fit self to stimulus Target: self versus not self
Feelings	Anger Fear Sadness Happiness	Valence Arousal Values of all other components reflected in consciousness

thought to operate on image-like representations and are rigid but automatic. These assumptions, however, have not been tested empirically and may not necessarily hold (cf. Moors, 2010). It is possible that both rule-based and associative mechanisms can operate on all kinds of representations and that they can both take place in an automatic or a nonautomatic way.

Another remark is that within the three classes of mechanisms presented here, there is still room for a variety of detailed proposals. For example, Scherer's (2009) component process model (CPM) predicts that the appraisal factors are often processed sequentially, in a fixed order. To be precise, the CPM assumes that the processes operate in parallel, but that they achieve *preliminary closure* (i.e., a reasonably definitive output) in a sequential way. The sequence assumption is based on phylogenetic, ontogenetic, and microgenetic considerations (Scherer, 1984, pp. 313–314; Scherer, Zentner, & Stern, 2004) and received support from experiments using brain activity, peripheral measures, and expression patterns (cf. Scherer, 2009). Other appraisal theorists posit that appraisal factors are processed

TABLE 8.2. Predicted Effects of Molecular Appraisal Factors on Molecular Values of Other Emotion Components

Appraisal values	Examples of expected effects on AT, PR, and EB
Novel and goal relevant	AT: Orienting PR: Heart rate deceleration, pupillary dilatation EB: Eyebrows and lids raised, jaw drop, gaze-directed pausing of speech and action
Intrinsically positive	AT: Sensitization PR: Heart rate deceleration, salivation, pupillary dilatation EB: Lids up, open mouth and nostrils, lips part with corners pulled up increase in low frequency voice energy, soft speech, approach locomotion
Intrinsically negative	AT: Defense response PR: Heart rate acceleration EB: Brow lowering, nose wrinkling, upper lip rising, nostril compression, gaze aversion, avoidance locomotion
Goal congruent	AT: Relaxation PR: Decrease in respiration and heart rate decrease, decrease in general muscle tone EB: Voice pitch and loudness decrease
Goal incongruent	AT: Activation PR: Increase in respiration and heart rate, strong increase in muscle tension EB: Frowning, lids tightening, lips pressed together, chin raising, gaze-directed; high and loud voice
No or low control	AT: Adjustment/withdrawal PR: Decrease in respiration and heart rate, hypotonus of the musculature EB: Lip corner depression, lips parting, jaw drops, lids droop, inner brow raises and outer brow lowers, gaze aversion; low and loud voice; few and slowed movements, slumped posture
High control/high power	AT: Assertion/dominance PR: Strong increase in respiration rate and depth; slight heart rate decrease; increase in systolic and diastolic blood pressure; increased blood flow to head, chest, and hands (reddening, increased skin temperature in upper torso); pupillary constriction; balanced muscle tone; tension increase in head and neck EB: Eyebrows contract, lids tight, eyes narrow, lips tight and parted, bare teeth or lips tight, pressed together, nostril dilation, stare; low and loud voice; strong energy in entire frequency range; agonistic hand/arm movements; erect posture, body leaning forward, approach locomotion
Control possible/low power	AT: Protection/submission PR: Extreme, faster, and more irregular respiration; strong increase in heart rate; increase in pulse volume amplitude; vasoconstriction in skin (pallor, decreased skin temperature), gastrointestinal tract, and sexual organs; increase in blood flow to striped musculature; stomach upset, goose bumps, sweating, trembling EB: Brow and lid raising, mouth stretch and corner retraction, high-pitched voice, protective hand/arm movements, fast locomotion or freezing

Note. See also Table 8.1. AT, action tendencies; PR, physiological responses; EB, expressive behavior. Adapted from Table 5.3 in Scherer (2001). Copyright 2001 by Oxford University Press. Adapted by permission.

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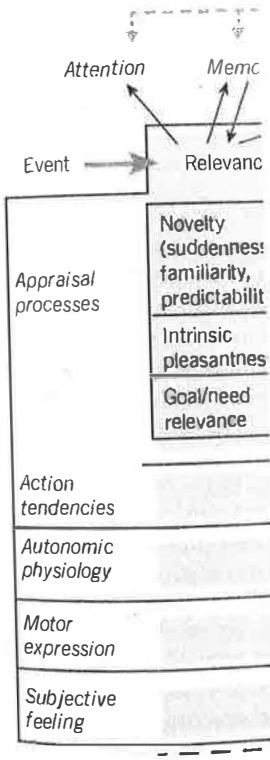


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in a partially sequential way or simultaneously. Figure 8.2 gives a schematic overview of the predictions of the CPM. The horizontal panel, labeled *appraisal processes* (also called *appraisal checks*), shows the different groups of appraisal factors (with the individual appraisal factors within each respective group) organized in the predicted sequence (see Ellsworth & Scherer, 2003; Scherer, 2001, 2009) together with the respective cognitive faculties (attention, memory, motivation, reasoning, self) that are recruited in these appraisal processes. The downward arrows represent the input of the cognitive faculties into the appraisal process (e.g., memory retrieval based on similarity), and the upward arrows represent a modification of these structures by the appraisal results (e.g., redirection of attention by a relevance appraisal). It may be noted that the sequence assumption is most pertinent for rule-based appraisal. In the case of associative appraisal, the appraisal values may become available in sequence or all at once.

With regard to the second step in the stimulus-to-components chain, there are two broad proposals. According to a first proposal, the appraisal values are integrated in a pattern before affecting the ensuing emotion (Smith & Kirby, 2001). According to a second proposal (cf. Scherer, 2009), each appraisal value has a separate influence on each of the other components in the emotion. According to a variant of this proposal, the influence of each appraisal value on the other components is mediated by the motivational component. In the CPM, for example, each appraisal value triggers an action tendency value shaping the values of the somatic and expressive components. In Figure 8.2, the other components are presented in the horizontal panels below the appraisal

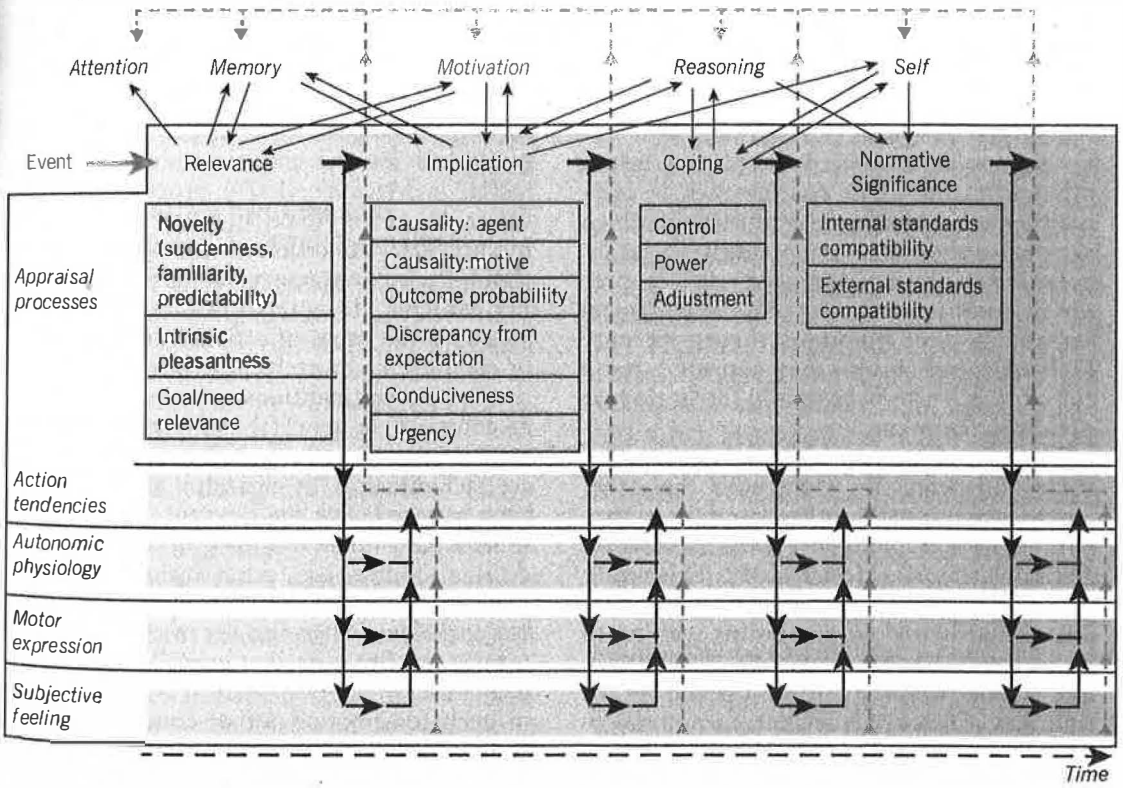


FIGURE 8.2. Predictions of the component process model on the sequential mechanisms involved in appraisal and their efferent effects on the various other components, highlighting the recursive and cumulative nature of the emotion episode. Adapted from Sander et al. (2005). Copyright 2005. Adapted with permission from Elsevier.

panel. The bold downward arrows illustrate the assumption that the appraisal values immediately, sequentially, and cumulatively influence the values of all other components. The feeling component integrates the changes in all the other components. Feelings correspond to representations of the multicomponential changes in the central nervous system. The dotted upward arrows represent the changes fed back to the appraisal process (and the cognitive structures subserving the appraisal process) where they may produce modifications of prior appraisals (i.e., reappraisal). This recursive feature of the model makes it radically dynamic.

The CPM clearly distinguishes between emotion episodes and the categorization or labeling of these episodes. The representation of the multicomponential changes triggered by certain appraisal outcomes in the central nervous system does not require, in and of itself, consciousness, categorization, or labeling. Rather, the latter processes are determined by many additional factors and the chosen category or label may represent only part of the emotion episode (see Scherer, 2009, pp. 1318–1323).

The first proposal (that all appraisal values need to be integrated in a pattern before influencing the other components) is compatible with a basic emotions view in which each basic emotion corresponds to a specific appraisal pattern. Moreover, such a proposal is not incompatible with a biological version of basic emotions theory, because each appraisal pattern may activate a brain circuit (i.e., affect program) dedicated to each basic emotion.

The second proposal (that each appraisal value independently influences the other components), on the other hand, is incompatible with a biological version of basic emotions theory (Moors, 2012; Scherer & Ellgring, 2007). Emotions are not latent constructs hardwired in our brains waiting to be triggered by the right appraisal pattern, like a lock that needs to be opened by the right key. They are emergent phenomena in the sense that their quality and intensity are shaped gradually with every additional piece of information resulting from each appraisal check. In line with this, the CPM does not assume the existence of a limited set of basic emotions, but considers the possibility of an infinite number of emotions (e.g., the generic term *anger* may cover annoyance, exasperation, fury, gall, indignation, infuriation, irritation, outrage, petulance, rage, resentment, and vexation). Although other theories also accept the existence of "families" of emotions covering many shades, they do not explain how these shades come about. In contrast, appraisal theories explain the infinite variety by referring to the infinite number of possible appraisal configurations. We wish to note that the CPM does allow for so-called *modal* emotions (Scherer, 1994), such as anger and fear, that occur more frequently and engender more-or-less stereotypical responses to a frequently occurring type of event or stimulus (see Table 1 in Scherer, 2009).

Empirical Support for the Causal Claim

In this section, we examine the kind of empirical research that should be conducted to investigate the causal claim of appraisal theories. Before we do so, it is worth spending a few lines on what the term *causation* means. There are many approaches to causation. One approach that provides useful guidelines for the empirical study of causation is Mackie's (1974) proposal that a cause, C, of an effect, E, is an insufficient but necessary condition in a set of conditions that is itself unnecessary but sufficient for E. For example, dropping a lit cigarette in the woods is the cause of a fire if dropping the lit cigarette is, in itself, insufficient to cause the fire (other conditions are necessary, such as combustible material and oxygen), but it is a necessary part of a set of conditions (a set including the lit cigarette, the combustible material, and the oxygen) that is itself unnecessary (there may be other sets of conditions for fire, e.g., a set including a fire cracker, combustible material, and oxygen) but sufficient (when this set of conditions is present the fire is present as well). Appraisal is a cause of emotion when it is insufficient in itself for emotion (other conditions may be necessary, such as the condition that appraisal must have a certain output, e.g., goal relevant, goal congruent, goal incongruent, positive, negative, novel, or urgent), but it is a necessary part of a set of conditions that is itself unnecessary but sufficient for emotion. Based on this definition of cau-

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sation, investigators who want to show that appraisal is a cause of emotion should find a set of conditions that is sufficient for emotion and demonstrate that appraisal is present in this set. In addition, they should demonstrate that the set is no longer sufficient when appraisal is eliminated from it.

We have argued that appraisal theories consider appraisal as a typical cause of emotion. Demonstrating that appraisal is a typical (let alone necessary) cause of emotion, however, is not a realistic aim of study. One cannot study most (let alone all) sets of conditions that are sufficient for emotion and demonstrate that appraisal is present in all these sets and that elimination of appraisal from these sets makes them insufficient. A more realistic aim is to demonstrate that appraisal is *a* cause of emotion (i.e., that there is one sufficient set of conditions in which appraisal is necessary), and preferably, to provide cumulative or converging evidence for this (i.e., that there are many sufficient sets of conditions in which appraisal is necessary). Emotion causation can be studied on all three levels of analysis. We focus here on ways to investigate emotion causation at the functional and algorithmic levels.

Testing Causal Hypotheses at the Functional Level of Analysis

The claim that appraisal causes emotion entails that appraisal not only determines the occurrence of emotions but also their intensity and quality. In addition to the general claim that appraisal determines the occurrence, intensity, and quality of emotions, appraisal theories also make specific claims about the specific appraisal factors involved in each of these effects (occurrence, intensity, and quality).

The general claim that appraisal causes emotions (with an intensity and quality) can be studied by comparing one set of conditions in which appraisal is present with another set in which appraisal is absent (independent variable) and by registering the presence or absence of emotion (dependent variable). To manipulate the presence or absence of appraisal, appraisal must be instantiated; that is, one must choose a certain pattern of appraisal values to be present or absent. Failure to find an effect does not, ipso facto, mean that appraisal does not cause emotions. It may also mean that the wrong pattern of appraisal values was chosen.

The specific claims (about the specific appraisal factors involved in the occurrence, intensity, and quality of emotions) can be studied by manipulating the appraisal factors figuring in them and by measuring the presence or absence of emotions, their intensity, and their quality. Again, failure to find an effect of one of these appraisal factors means that the specific claim is false and requires adjustment, but not that the general claim is false as well. In the next sections, we discuss ways in which to manipulate appraisal processes and ways to measure the other components. For historical reasons, we first briefly review early studies in which appraisal was not manipulated but merely measured.

Measurement of Appraisal

Appraisals have been measured with self-report, based on the assumption that people have conscious access to appraisal on a functional level of analysis. In recall studies, participants are asked to recall emotion episodes (e.g., anger) and to rate the respective appraisals (e.g., who caused the event; Mauro, Sato, & Tucker, 1992; Roseman, Spindel, & Jose, 1990; Scherer, 1993; Scherer & Wallbott, 1994). A few studies measured appraisals in real-life situations. For instance, Smith and Ellsworth (1987) studied students' appraisals before and after taking an exam. Scherer and Ceschi (1997) measured appraisals of airline passengers immediately after having registered lost luggage. Although such self-report studies suggest the plausibility of the causal claim, experimental manipulation of appraisal is required to obtain empirical evidence.

Manipulation of Appraisal

Appraisal factors can be manipulated in a variety of ways: either (1) directly, with verbal stimuli that literally refer to appraisal values, or (2) indirectly, by manipulating stimuli in the expectation that participants will appraise them in a certain way, but without explicit verbal reference to appraisal values. In indirect methods, the to-be-appraised stimuli can be (1) really present

(e.g., a real dog appears), or (2) externally represented in visual (e.g., picture of a dog) or verbal form (e.g., the word *dog*).

Examples of procedures in which real events are manipulated are experiments (1) presented as ability tests (Kreibig, Gendolla, & Scherer, 2010; Kulik & Brown, 1979; McGregor, Nash, & Inzlicht, 2009; Mikulincer, 1988; Smith & Kirby, 2009; Smith & Pope, 1992) or (2) construed as interactive games (e.g., ultimatum games; Harle & Sanfey, 2010; Yamagishi et al., 2009) in which participants compete with real (e.g., Bossuyt, Moors, & De Houwer, 2012; Cherek, Lane, & Pietras, 2003; McCloskey, Berman, & Coccaro, 2005) or virtual opponents (Johnstone, van Reekum, Hird, Kirsner, & Scherer, 2005; Kappas & Pecchinenda, 1999; Nelissen & Zeelenberg, 2009). In these experiments, participants encounter events that are (1) relevant or irrelevant for goals (Moors & De Houwer, 2001), (2) congruent or incongruent with goals (e.g., the goal to achieve, or to win a prize; Moors & De Houwer, 2001; Smith & Pope, 1992), (3) pleasant or unpleasant (e.g., words, pictures, sound blasts, electroshocks, tastes, virtual enemies; Geen, 1978; Johnstone et al., 2005; Roseman & Evdokas, 2004), (4) easy or difficult to cope with (e.g., Cherek, Spiga, Steinberg, & Kelly, 1990; Galinsky, Gruenfeld, & Magee, 2003; Geen, 1978; McCloskey et al., 2005), (5) certain or uncertain (e.g., Roseman & Evdokas, 2004), (6) caused by themselves or by others (Bossuyt et al., 2012), and (7) fair or unfair (e.g., Batson et al., 2007; Weiss, Suckow, & Cropanzano, 1999). In all these experiments, researchers expect participants to appraise the stimuli in the intended way.

Procedures in which the to-be-appraised stimuli or events are not really present but externally represented in verbal (words or stories) or visual form (pictures or films) are scenario studies and recall studies. In scenario studies (e.g., Kuppens, Van Mechelen, Smits, De Boeck, & Ceulemans, 2007; Robinson & Clore, 2001; Zeelenberg, van Dijk, & Manstead, 1998), participants are presented with fictitious events (verbal or visual) and instructed or expected to imagine that these events would happen to them. In recall studies, participants receive verbal instructions to retrieve events from their past. In both scenario and recall studies, appraisals can be manipulated directly or indirectly. In the direct case, instructions literally refer to appraisal values (e.g., "Imagine that you have low power," Smith & Bargh, 2008; "Recall an event in which you had low power," Fast & Chen, 2009; Galinsky et al., 2003; Kuppens, Van Mechelen, Smits, & De Boeck, 2003; Lammers, Galinsky, Gordijn, & Otten, 2008). In the indirect case, events are described or depicted without explicit reference to appraisal values (e.g., de Hooge, Zeelenberg, & Breugelmans, 2010; Kuppens et al., 2007)

At least three issues are important to consider when choosing procedures for manipulating appraisal factors. A first issue is that of controlling for confounding variables. Procedures with real events in the laboratory allow for more control over confounding variables than those with imagined or recalled events. For instance, coping potential can be manipulated by leaving a door open or closed in a computer game or by telling participants that a door is open or closed in a verbal scenario. In the computer game, participants have no way to escape, whereas in the verbal scenario, they may imagine escape via a window. If we compare scenario procedures of the indirect (in which events are described in an appraisal-free manner) and direct type (in which events are described in appraisal terms), we argue that the former allows for more control over the confounding variables related to the concrete details of the events, whereas the latter allows for more control over confounding appraisal factors. For example, the scenario of hitting one's head against the kitchen cabinet (i.e., indirect type) allows the researcher to control the concrete features of the event, but not whether the person appraises the event merely as goal incongruent or as also caused by another agent (e.g., when the kitchen cabinet is treated as an agent for a split second). The scenario of appraising another person as the cause of a goal-incongruent event (i.e., direct type) allows less control over the concrete features of the event (many concrete events can be imagined that fit this appraisal pattern), but more control over the appraisal factors (the event is appraised as goal incongruent and caused by another person).

A second issue is the extent to which the processes induced by the manipulation resemble the processes induced by real

emotion-eliciting events outside the laboratory. Compared to externally represented events, real events in the laboratory are more likely to induce the same processes as real events outside the laboratory. Many authors have suggested that externally represented events activate knowledge about the relation between appraisals and emotions, whereas real events induce real emotion-eliciting processes (e.g., Parkinson, 1997). The fact that externally represented events (e.g., films) can also elicit emotions raises the question of whether the activation of knowledge differs from so-called real emotion-eliciting processes, and as a consequence, whether the emotions elicited by externally represented events are of a special kind (e.g., Levinson, 1990; Radford, 1995). There is reason to believe that the activation of knowledge is especially likely when verbal material is used.

To summarize, the manipulation of real events has the advantage that there is control over confounding variables, but the disadvantage that one cannot be entirely sure that the participants appraise the events in the way the researcher expects them to. This is not always a problem and it can partly be met by adding a manipulation check. The manipulation of externally represented events that refer explicitly to appraisal factors allows one to have more control over the appraisal factors at stake, but runs the risk of inducing processes (e.g., the activation of conceptual knowledge) that are different from the ones induced by real events.

Measurement of Other Components

Measurement of the other components in the emotion episode can be done with a variety of procedures: objective and subjective ones and direct and indirect ones. Objective measures produce responses that are verifiable by others; subjective measures do not (cf. Muckler, 1992). Examples of objective measures are ones producing reaction times or other aspects of motor responses, electroencephalographic (EEG) signals, and skin conductance responses. Subjective measures rely on reports by internal (i.e., self-reports) or external observers, at least when the content of the reports is considered as the response (and not objective aspects such as reaction times). Subjective measures are suitable only for constructs that are (to some extent) consciously accessible to the observer.

Following De Houwer and Moors (2010), we call a measure *direct* when the researcher uses the responses as a direct readout of the values of the to-be-measured variable. For example, self-reports of action tendencies (e.g., "I had the tendency to attack"; e.g., Frijda, Kuipers, & ter Schure, 1989) directly deliver the values of the to-be-measured variable of action tendencies. Likewise, a heart rate monitor directly delivers the values of the to-be-measured variable of heart rate. We call a measure *indirect* when the researcher derives the values of the to-be-measured variable from the values of another variable that is assumed to be influenced by the to-be-measured variable. For example, motor responses can be used as an indirect measure of action tendencies (e.g., Martinez, Zeelenberg, & Rijsman, 2011), based on the assumption that motor responses are influenced by action tendencies.

Components referring to overt responses, such as somatic and motor components, are preferably measured with direct measures, either objective ones (heart rate, blood pressure, skin conductance, overt behavior) or subjective ones (self-reports of somatic and motor responses). Components referring to internal constructs, such as action tendencies and feelings, cannot be measured with direct objective measures (they cannot be read out directly from responses that are verifiable by others). They can be measured with indirect objective measures (e.g., using behavior to infer the presence of action tendencies), direct subjective measures (e.g., self-reports of action tendencies and feelings; de Hooge et al., 2010; Frijda et al., 1989), and indirect subjective measures (e.g., using self-reports of behavior to infer the presence of action tendencies).

Testing Causal Hypotheses at the Algorithmic Level of Analysis

In addition to research about the functional level, there is also need to do research about the algorithmic level and about the link between both levels. In the present section, we consider empirical evidence for one specific hypothesis proposed by the CPM: that appraisal factors influence the other components in a sequential fashion. Various stud-

ies demonstrate that appraisal checks have a sequential influence on facial expressions and peripheral and central physiological activity. Lanctôt and Hess (2007) showed a sequential influence of intrinsic valence and goal congruence on zygomaticus and corrugator activity measured with electromyography (EMG). Aue, Flykt, and Scherer (2007) showed sequential effects of appraisals on heart rate and facial muscle innervations. Delplanque and colleagues (2009) showed that the appraisal of an odor as novel or familiar produces earlier effects on facial expressions (using EMG) and physiological reactions (using electrocardiogram and electrodermal activity) than the appraisal of the odor as positive or negative. Grandjean and Scherer (2008) and van Peer, Grandjean, and Scherer (2012) manipulated novelty, goal relevance, intrinsic valence, and goal congruence appraisals in visual stimuli and observed their sequential influence on EEG recordings (using topographical analyses of the event-related potentials and frequency bands). Gentsch, Grandjean, and Scherer (2013) extended this approach by showing that the coping potential check occurred after the goal congruence check. Empirical support for the sequence hypothesis strengthens the causal claim defended in this chapter. The observation that different appraisal factors affect the other components at different points in time suggests that they are supported by mechanisms with different latencies. This, in turn, suggests that appraisal is an intervening mental process and not merely a description of the stimulus situation.

Conclusion

There is now fair agreement among emotion theories that emotions are multicomponential episodes and that appraisal is a component in these episodes (Frijda, 2007; Moors, Ellsworth, Scherer, & Frijda, in press). The family of appraisal theories, however, goes beyond the facile inclusion of appraisal as one of many components in emotion episodes by arguing for a strong causal role of appraisal in determining the other components. As a consequence, appraisal is considered to be a major determinant of the content of feelings.

In a detailed exploration of the causal claim, we listed possible hypotheses about two steps in the stimulus-to-components chain (the step in which the stimulus is appraised and the step in which the output of appraisal influences the remaining components) at the functional and algorithmic levels of analysis.

We discussed methods to investigate hypotheses of appraisal theories formulated at the functional level of analysis. The general claim that appraisal is a typical cause of emotion is difficult if not impossible to prove in a definitive way. To support the plausibility of this claim, however, appraisal researchers are invited to provide cumulative support for it. The specific hypotheses about the specific appraisal factors that determine the presence, intensity, and quality of emotions or components are easier to study, relatively speaking. We listed ways to manipulate appraisals and ways to measure other emotional components. For the manipulation of appraisal, we distinguished between direct and indirect methods, and between methods using real events and externally represented events. For the measurement of emotions or emotional components, we distinguished between objective and subjective methods and between direct and indirect methods. Each method for the manipulation of appraisal can be combined with each method for measuring emotions or components. Contemporary appraisal researchers not only try to answer questions at the functional level of analysis, but also at the algorithmic level. To illustrate this, we discussed recent empirical support for the sequence hypothesis of the CPM (Scherer, 2009).

Central questions in emotion research concern how emotions come about and what factors determine their intensity and quality. Appraisal theories take up the challenge by proposing and testing hypotheses about the nature of these determinants (in the form of appraisal factors and values) and by specifying detailed links between these determinants and their effects (values on the other components). Appraisal is presented as a mental process that is specifically concerned with the postulated appraisal factors. Thus, the appraisal factors are more than descriptors of the situations that elicit emotions; they are the types of information that

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are somehow processed by the organism. The question of how they are processed is addressed in hypotheses about the underlying mechanisms and representations.

By defending the causal role of appraisal in emotions, appraisal theories put themselves in a vulnerable position. Empirical proof for causation is never definitive (even in experimental studies), and alternative explanations always lie in wait. Many appraisal theorists accept other processes than appraisal as possible causes of emotions, but only in marginal cases. The difficulty to prove that appraisal is a cause of emotions, let alone a typical cause, is not *in itself* a reason to reject it or to put forward other processes as typical causes. They too need to stand the test of causation. Unfortunately, many alternative emotion theories do not provide sufficiently precise hypotheses to allow rigorous empirical testing.

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