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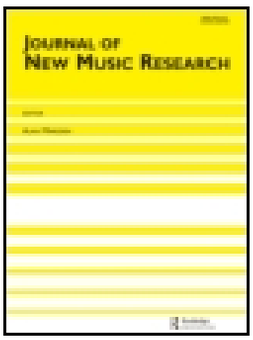

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Which Emotions Can be Induced by Music? What Are the Underlying Mechanisms? And How Can We Measure Them?

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Abstract

The study of emotional effects of music is handicapped by a lack of appropriate research paradigms and methods, due to a dearth of conceptual-theoretical analyses of the process underlying emotion production via music. It is shown that none of the three major assessment methods for emotion induction – lists of basic emotions, valence-arousal dimensions, and eclectic emotion inventories – is well suited to the task. By focusing on a small number of evolutionarily continuous basic emotions one downplays the more complex forms of emotional processes in humans, especially affective feeling states produced by music which do not serve adaptive behavioral functions. Similarly, a description of emotional effects of music limited to valence and arousal gradations precludes assessment of the kind of qualitative differentiation required by the study of the subtle emotional effects of music. Finally, eclectic lists of emotions generated by researchers to suit the needs of a particular study may lack validity and reliability and render a comparison of research results difficult. A second problem consists in the tendency to assume that "emotions" and "feelings" are synonyms. It is suggested that "feelings" can be profitably conceptualized as a central component of emotion, which integrates all other components and serves as the basis for the conscious representation of emotional processes and for affect regulation. It is proposed that a radical paradigm change is required to free research on the emotional effects of music from the excessive constraints imposed by these two common misconceptions. Concretely, it is suggested that affect produced by music should be studied as (more or less conscious) feelings that integrate cognitive and physiological effects, which may be accounted for by widely different production rules. Suggestions for new ways of measuring affective states induced by music are made.

1. Introduction

The notion that music *expresses* emotion has a venerable history and its validity is rarely debated. There is less agreement on how music expresses such affective content and exactly what emotions are most likely to be expressed. The related notion that music *induces or produces* emotions in listeners also has a venerable history but its validity is still under debate. The extensive literature on these two notions does not need reviewing here; the recent volume on *Music and Emotion* edited by Patrick Juslin and John Sloboda (2001) provides an exhaustive repository of theory and research in this domain. Rather, this contribution will deal with the meaning of the term *emotion* and how to measure it. Based on current psychological models of emotion, I will review the different kinds of affective phenomena and their characteristics and examine the likelihood that they will be expressed and/or produced by music. Apart from its obvious theoretical significance (as regularly debated by philosophers), this issue has direct relevance for the methodology in this area of research, particularly with respect to the affect categories or scales used to obtain listener judgments on the affect that is expressed or produced by musical stimuli.

Research on the emotional effects of music is usually conducted by presenting different pieces of (mostly classical) music, selected for their presumed emotion generation potential, to listeners who are asked to record their emotional reactions to each piece. While listeners are sometimes asked to describe their experiences in their own words, more often they are asked to fill out a standard rating sheet of some sort. It should be noted that such rating sheets generally measure the subjective perception of *expressed emotion* rather than *felt emotion* (see review in Gabrielson & Juslin, 2001). Even though these two objects of self report can be clearly distinguished even by lay persons (Zentner, 2000), and presumably

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even better by professionals (Scherer et al., 2002), it may well be impossible clearly to separate these two types of reports even if precise instructions are provided.

In any case, the nature of the emotion inventory used is obviously of paramount importance for the results and the interpretation of the respective studies. Given that the answer format is fixed, listeners can only signal an experience of those categories of emotion that are listed in the inventory (or choose a category that comes as close as possible to the feeling state they experienced). The advantages and disadvantages of forcing judgments into the corset of a pre-established set of categories have been widely discussed in the area of emotion expression (Ekman, 1994; Russell, 1994). While it can be shown that the disadvantages of using fixed response categories are less preoccupying in the case of studying basic emotions (especially in the case of prototypical facial expressions), they may be very real in the case of less categorical and prototypical domains of feeling. In the case of affective reactions to music, one cannot assume a priori that the induced emotional states correspond to prototypical emotions similar to the basic emotions portrayed by the facial expressions of actors in much of emotion research. Rather, it is the ultimate aim of research in this domain to find out exactly what kinds of affective experiences can be induced by music. In consequence, it is of utmost importance to ensure that the measurement instrument used for this purpose will not bias the results in one way or another.

Unfortunately, the choice of a particular emotional response scheme presented to listeners does necessarily reflect a theoretical choice and consequently severely biases research results. One can distinguish three major schools of thought in this respect, the basic emotion, the emotional dimension, and the eclectic approach. The former two are more or less firmly rooted in established theories of emotion – discrete emotion theory and dimensional theory. Discrete emotion theory advocates the measurement of a small number of basic or fundamental emotions, such as anger, fear, joy, and sadness, whereas dimensional theories suggest ratings of valence (positive–negative) and activation (aroused–calm) experiences. The eclectic approach consists in choosing verbal labels that seem appropriate to the aims of a particular study, choosing terms from the rich affect vocabulary that seems particularly appropriate to the pieces of music used in a particular study (such as nostalgic, triumphant, or exhilarating). This diversity in the ways in which musical expressiveness or affective reactions to music are measured makes it very difficult to compare findings from studies using a different theoretical approach and different conceptualizations and measures of the affective phenomena under investigation.

Apart from this difficulty, which impedes a systematic accumulation of knowledge, one may also ask which of the three theoretical approaches is best suited to examine the emotional effects of music on listeners. In this contribution I argue against the use of the two first approaches in music research, and advocate a paradigm shift in the direction of making the eclectic approach more systematic by providing a theoretical basis for differentiating emotion and feeling and by developing instruments that are based on empirical research. To prepare the argument, I will first provide a brief survey of the nature of emotion.

2. The nature of emotion

One of the first tasks is to define more carefully what exactly is meant by *emotion*. This term, used widely in everyday language, constitutes a hypothetical construct, i.e., a conceptual and operational definition of an underlying phenomenon that constitutes the object of theory and research. Most modern emotion theorists have adopted a *componential approach to emotion*, suggesting that an emotion episode consists of coordinated changes in several components. Across the centuries, three major reaction components of emotion: physiological arousal, motor expression, and subjective feeling (the emotional response triad) have been identified. More recently, behavior preparation (action readiness, action tendencies) as well as the concomitant cognitive processes that elicit and differentiate emotional reaction patterns, have been added to the list of components.

2.1 Physiological arousal

Physiological changes such as temperature sensations, respiratory and cardiovascular accelerations and decelerations, trembling and muscle spasms, as well as feelings of constriction in internal organs, are frequently part of emotion descriptions (Ekman et al., 1983; Frijda, 1986; Stemmler, 2004). These neurophysiological changes in emotional episodes is are generally attributed to (1) the emotion eliciting event disturbing ongoing homeostatic regulation and smooth behavioral coordination, and (2) the preparation of appropriate adaptive responses (e.g., producing the necessary energy for appropriate actions such as fight or flight).

2.2 Motor expression

Facial and vocal expression, as well as gestures and posture, during emotion episodes are generally considered to be central motor components of emotion (Ekman, 1984, 1992; Izard, 1971). Darwin (1872/1998) conceptualized expressions as rudiments of formerly adaptive behaviors (e.g., clenching one's teeth as a rudiment of a biting response). In addition, emotion researchers have highlighted the communicative functions of emotional expressions, informing others of an individual's reaction and its corresponding behavior intentions (Ekman, 1992; Frijda, 1986; Scherer, 1984; Tomkins, 1962).

2.3 Subjective feeling

Individuals verbally report a multitude of qualitatively different feelings, using a rich emotion vocabulary. These inter-

nal sensations, often considered as necessarily conscious experiences, constitute irreducible qualities of feeling unique to the specific emotional experience of a particular individual (Frijda, 1986; Lazarus, 1991; Ortony & Turner, 1990). I have suggested that the feeling component of emotion can be conceptualized as a reflection of *all* changes in components during an emotion episode, i.e., the results of event appraisal, motivational change, and proprioceptive feedback from motor expression and physiological reactions. It is important to define differentially the concepts in this fashion, as the tendency to use emotion (the process as a whole) and feeling (one of its components) as synonyms results in confusion (Scherer, 2000).

2.4 Behavior preparation

Emotion theories of an explicitly componential persuasion have explicitly postulated a motivational function of emotional responses in the form of behavior preparation or action tendencies (Frijda, 1986; Scherer, 1984). Emotions interrupt ongoing goal-directed behavior and produce action tendencies that are specifically adapted to dealing with the environmental contingency that has elicited the emotional response. Importantly, this component of emotion generally prepares a general behavior readiness as well as several alternative action tendencies, allowing the organism to choose according to context and strategic considerations.

2.5 Cognitive processes

Emotions also have a cognitive component. This component consists of the appraisal processes that drive the coordinated changes in the components described above. Proponents of appraisal theories of emotion (see contributions in Scherer et al., 2001) suggest that emotional reactions are determined by the subjective evaluation of events with respect to their significance for the well-being and goal attainment of individuals. In addition, emotions often have strong effects on perceptual and cognitive processes such as attention, thinking, memory, problem solving, judgment, decision making and the like (see contributions in Dalgleish & Power, 1999). This appraisal–response sequence is recursive (e.g., the evaluation of an event as dangerous may produce fear which in turn may affect the ensuing evaluation of subsequent events).

If we want examine whether music produces emotions, in the sense of the construct defined above, we need to measure all components, something that has not been attempted so far. Furthermore, if one subscribes to the notion that the changes in the components are highly synchronized during an emotion episode when they are coupled in the interest of optimal adaptation to the eliciting circumstances, the degree of coupling would need to be examined. Again, this has, to my knowledge, not been attempted so far. The large majority of studies on the emotional effects of music have requested verbal report of the consciously experienced emotion – in other words, the subjective feeling component, although there are a few studies on physiological patterns and action tendencies (Bartlett, 1999; Scherer & Zentner, 2001).

3. A music-oriented design-feature based differential definition of affective states

The component process model outlined above defines the construct of emotion. Unfortunately, this term is often used quasi-synonymously with many different terms. In response to some of the rampant confusions in the area of emotion research, I have suggested a design-feature approach to distinguish conceptually some of the major categories of affective states (Scherer, 2000). The proposed design features included typical intensity and duration, the degree of coordination or synchronization of different organismic systems during the state, the extent to which the change in state is triggered by or focused on an event or a situation, the extent to which the differentiated nature of the state is due to a process of antecedent evaluation or appraisal, the rapidity of change in the nature of the state, and the degree to which the state affects behavior.

Recently, Scherer and Zentner (2001) have suggested using this approach in trying to understand the affective effects of music, pointing out that a comprehensive effort in this direction would require a more explicit consideration of *aesthetic emotions*. In this piece, I present a first effort to do just this. Table 1 presents a more elaborated version of the design feature analysis presented earlier, specifically distinguishing aesthetic emotions from what I suggest to call *utilitarian emotions*. The latter correspond to the types of emotions that are usually studied in emotion research – for example, anger, fear, joy, disgust, sadness, shame, guilt. These are utilitarian in the sense of having major functions in the adaptation and adjustment of individuals to events that have important consequences for their well being by preparing action tendencies (fight, flight), recovery and reorientation (grief work), motivational enhancement (joy, pride), social obligations (reparation), etc. As shown by appraisal theories of emotion, the functionality of these emotions is based on a prior analysis of the behavioral meaning of events for the needs and goals of the individual, taking into account the latter's power and coping potential. In addition, some of these emotions (especially anger, shame, and guilt) are shaped by the appraisal of the compatibility of actions (by self and other) in terms of justice or compatibility with social norms or moral standards (see the comprehensive summary of appraisal approaches in Scherer et al., 2001). Such utilitarian emotions are high-intensity emergency reactions, often involving a synchronization of many organismic subsystems, including coordinated changes in the endocrine, hormonal and autonomous nervous systems as well as in the somatic nervous system (striated musculature, both for social expression and action preparation) which are driven by the appraisals in the central nervous system. Because of the strong involvement of different bodily systems, it

Table 1.

Type of affective state: brief definition (*examples*)	Design feature								
	Intensity	Duration	Synchronization	Event focus	Intrinsic Appraisal	Transactional Appraisal	Rapidity of change	Behavioral impact	Probability of induction via music
Preferences: evaluative judgments of stimuli in the sense of liking or disliking, or preferring or not over another stimulus (*like, dislike*, *positive, negative*)	L	M	VL	VH	VH	M	VL	M	H
Utilitarian emotions: relatively brief episodes of synchronized response of all or most organismic subsystems in response to the evaluation of an external or internal event as being of major significance for personal goals or needs (*angry, sad, joyful, fearful, ashamed, proud, elated, desperate*)	H	L	VH	VH	M	VH	VH	VH	H
Aesthetic emotions: evaluations of auditory or visual stimuli in terms of intrinsic qualities of form or relationship of elements (*moved, awed, surprised, full of wonder, admiration, bliss, ecstasy, fascination, harmony, rapture, solemnity*)	L-M	L	M	H	VH	L	H	M	VH

Mood: diffuse affect state, most pronounced as change in subjective feeling, of low intensity but relatively long duration, often without apparent cause (*cheerful, gloomy, irritable, listless, depressed, buoyant*)	M	H	L	L	M	L	H	H	M
Interpersonal stances: affective stance taken toward another person in a specific interaction, coloring the interpersonal exchange in that situation (*distant, cold, warm, supportive, contemptuous*)	M	M	L	H	L	L	VH	H	L
Attitudes: relatively enduring, affectively colored beliefs and predispositions towards objects or persons (*loving, hating, valuing, desiring*)	M	H	VL	VL	L	L	L	L	M
Personality traits: emotionally laden, stable personality dispositions and behavior tendencies, typical for a person (*nervous, anxious, reckless, morose, hostile, envious, jealous*)	L	VH	VL	VL	L	VL	VL	L	VL

VL = very low; L = low; M = medium; H = high; LH = very high.

has become customary to consider emotions as *embodied states*.

I suggest that the major difference between utilitarian and aesthetic emotion consists in the absence of appraisals concerning goal relevance and coping potential in the case of the latter. In other words, an aesthetic experience is one that is *not* triggered by concerns with the relevance of a perception to my bodily needs, my social values, or my current goals or plans, nor with how well I can cope with the situation, but one where the *appreciation of the intrinsic qualities* of a piece of visual art or a piece of music is of paramount importance. This corresponds in many ways to Kant's well-known definition of aesthetic experience as "interesseloses Wohlgefallen" (*disinterested pleasure*; Kant, 2001), a definition which insists on the need for a complete absence of utilitarian considerations.

The absence of direct personal relevance in aesthetic emotions does not mean that they are completely disembodied. While there is still a dearth of research, we know that music (but also other forms of art) can be demonstrated to produce physiological and behavioral changes (Bartlett, 1999; Scherer & Zentner, 2001). However, the important difference is that these changes are not in the service of behavioral readiness or the preparation of specific, adaptive action tendencies (Frijda, 1986). They are not proactive but rather diffusely reactive. For example, the most commonly reported bodily symptoms for intense aesthetic experiences are goose pimples, shivers, tinkling on the spine, or moist eyes – all rather diffuse responses which contrast strongly with the arousal and action-oriented responses for many utilitarian emotions. Thus, aesthetic emotions can be embodied to some extent, but this aspect is generally weaker and not as highly synchronized across different organismic components as in the case of utilitarian emotions. It is the greater intensity of the subjective feeling and the potential embodiment that distinguish aesthetic emotions from simple preferences, listed in the first row of Table 1, consisting of brief unreflected valence judgments. In other words, compared to preferences aesthetic emotions are based on more comprehensive appraisal, including efferent reactions. However, in comparison to the appraisal underlying utilitarian emotions, which is always *transactional* (Lazarus, 1991), evaluating stimuli and events with respect to the criteria of the individual's needs, goals, values and his/her coping potential, in the case of aesthetic emotions appraisal is intrinsic to the visual or auditory stimulus, based on forms and relationships (Rahn, 1994; Scruton, 1997).

4. Mechanisms underlying emotion induction by music

In Table 1, I have ventured hypotheses as to the degree of probability that a particular affective state will be induced by music. The basis for these predictions is theoretical assumptions about the nature of the mechanisms that underlie emotion induction by music. In this section, I briefly review these presumed mechanisms. Scherer and Zentner (2001) have suggested a set of *production rules* for emotion induction by music. They suggest that music can produce emotion through central and peripheral mechanisms or *routes*.

4.1 Central route production

4.1.1 Appraisal

Scherer and Zentner suggest that musical stimuli may provoke emotions, in similar fashion as any other emotion-eliciting event, through a process of event evaluation or appraisal on a number of criteria or dimensions concerning the implications of the event for needs, goals, or values of the individual and his/her ability to cope with the consequences of the event. The result of this appraisal process is an emotion which is then expressed or externalized in physiological symptoms and, particularly, in motor expressive movements in face, body, and voice. In this theoretical tradition, the type of the ensuing emotion and the patterning of the physiological and expressive responses are seen as dependent on the specific profile of appraisal results on the pertinent criteria (see Scherer, 1999; Scherer et al., 2001). This suggestion seems to contradict the claims I made above, suggesting that music is unlikely to produce basic emotions with strong action tendencies but rather aesthetic emotions which are supposed to be independent of goal-oriented appraisal.

However, the contradiction is only apparent. Making the distinction between utilitarian and aesthetic emotions does not preclude that music can also produce a whole range of utilitarian emotions, possibly with the exception of strong fear or anger. There are a number of mechanisms whereby this can be achieved. One obvious case is the expectation of a pleasurable experience from music as a strong personal goal in itself. For example, if I have saved money to be able to go to a festival to hear a famous singer perform in one of my favorite operas, I will be disappointed and possibly irritated if it turns out that the singer is not well prepared and the orchestra plays in a lackluster fashion. Clearly, in this case it is not the music (let us say by Mozart) that is the cause of my emotion but the type of performance given certain expectations. However, the distinction between occasion, performance, and musical form cannot always be made very precisely. If I want peace and quiet to study, having to listen (through thin walls) to my neighbor's playing Indian sitar music or extreme techno for a lengthy period of time may produce negative emotions that could be attributed in part to the type of music. Thus, music can produce utilitarian emotions through appraisal mechanisms, and give rise to action tendencies such as approach and avoidance, for a large number of different circumstances.

Other types of appraisal processes that may be triggered by music occur in a rudimentary, automatic fashion at lower levels of the CNS (mostly the limbic system), especially for evolutionarily "prepared" stimuli, or in a more elaborated

and more effortful process involving the cortical association regions of the CNS as well as the lower centers (see Leventhal & Scherer, 1987; van Reekum & Scherer, 1998). For example, vocal expressions of emotions comparable to alarm calls in primates (see Jürgens, 1988) may be "prepared" stimuli with respect to low-level behavioral meaning. In consequence, musical stimuli sharing the acoustic characteristics of such fear vocalizations (sudden onset, high pitch, wide range, strong energy in the high frequency range) may be appraised by the evolutionarily primitive but extremely powerful detection systems and may provoke, like pictures of spiders or facial expressions of fear, physiological defense responses (see Öhman, 1988). Similar low-level detection mechanisms can be demonstrated for the appraisal criteria of suddenness/novelty (e.g., melodic and harmonic irregularities) and intrinsic pleasantness (e.g., dissonance; see Scherer & Zentner, 2001).

One of the criteria of event evaluation postulated by appraisal theory is the compatibility of a stimulus event with external (norms, cultural values) and internal standards (personal values). At first sight, this may seem as not very pertinent to musical affect. However, as for any form of art, there are social conventions on what is considered aesthetically pleasing or beautiful and what is to be rejected as a violation of "good taste" (Farnsworth, 1969; Kenyon, 1991). Often "modern" music is seen as an offense to established standards of morality and decency (as shown, for example, by the scandals provoked by Stravinsky's *Sacre du Printemps* or Varèse's *Deserts*). Again, the emotions provoked in these cases can be considered as utilitarian, since they are triggered by evaluation criteria that are linked to individual goals and social norms and values, rather than to intrinsic form. In consequence, music performances can, for many different reasons, provoke utilitarian emotions with the accompanying embodiment and action tendencies, based on transactional appraisal. It is important to note at this point, that many appraisal theorists do not share the notion that (utilitarian) emotions are restricted to a small number of basic or fundamental emotions. On the contrary: in my own theoretical account I even suggest that there are as many emotions as there are ways of appraising events (although much of everyday emotionality seems restricted to a smaller number of *modal* emotions; see Scherer, 1984, 1994).

4.1.2 Memory

Another central route highlighted by Scherer and Zentner as a mechanism of emotion induction is imagination or recall from memory. Here music serves to elicit associations to affectively loaded memories, which may evoke similar but weaker emotional reactions as in the original experience (Dalton, 1998; Tarrant et al., 1994). In fact, music seems to be one of the most powerful cues to bring emotional experiences from memory back into awareness. Scherer and Zentner ascribe this capacity to two factors: (1) music accompanying many highly significant events in an individual's life – religious ceremonies, marriage, burial rites, dancing and other festivities, etc., and (2) music, like odors, could be processed, at least in part, at levels of the brain that are particularly resistant to modifications by later input, contrary to cortically based episodic memory (e.g., LeDoux, 1992).

4.1.3 Empathy

A third central emotion induction mechanism mentioned by Scherer and Zentner is empathy with another person suffering from a certain emotion, either by contagion or by pity. One can show that this principle works equally well for virtual emotions, as in the case of film and theater. Similarly, expressive movements by singers or musical performers can lead empathy with the emotion presumed to be felt by the performer. Thus, emotion might be induced by the identification with a performer seen as living through an emotional experience produced by an underlying script, a process which might be particularly likely to occur in the case of listening to an admired performer acting in a highly emotional manner. Such a process would be quite comparable to similar processes described for the theatre, movies, or TV that are generally considered to induce real emotions in the viewer.

4.2 Peripheral route production

4.2.1 Proprioceptive feedback

The emotion system consists of integrated components and there is some evidence that the system as a whole can be activated by manipulating the patterning of one of its components (e.g., Ekman et al., 1983; McIntosh, 1996). Certain aspects of music, in particular rhythm and beat, are known to affect directly body rhythms and movements. Strong musical rhythms seem to have a contagious effect, with many individuals finding it difficult not to move their heads or their legs in unison with the rhythm (e.g., in the case of dance rhythms, marches, or techno beat). Such coupling of internal rhythms to external drivers, as extensively discussed by Byers (1976), may constitute a mechanism whereby music can be assumed to spread systematically to other emotion components, thus in fact producing emotion states that did not exist before. For example, given the close relationship of respiration and cardiovascular function, a change of respiration through musical rhythm would undoubtedly have an impact on a variety of neurophysiological systems (Boiten et al., 1994), in many ways similar to emotion-induced physiological changes.

4.2.2 Facilitating the expression of pre-existing emotions

A final effect of listening to emotionally arousing music, described by Scherer and Zentner, consists of a weakening or the elimination of control or regulation efforts imposed by cultural norms (Ekman, 1984; Goffman, 1959, 1971;

Hochschild, 1983; Scherer, 2000). Thus, moviegoers often report that, while watching a moving film, when the music started they could no longer hold back their tears. When a pre-existing tendency toward specific motor expressions and physiological reactions is reinforced by external stimulation, it may be much harder to keep affect under control.

5. Major theoretical traditions in measuring emotional experience

5.1 Basic emotions according to discrete emotion theory

Asking listeners to indicate the extent to which a piece of music evokes emotions like joy, sadness, anger, fear, and similar basic emotions, presumes that the affective state produced by the music is comparable to similar emotions experienced in "real life", in the normal course of a person's activity, outside of a music-listening context. To evaluate this assumption, one needs to keep the nature and functions of such basic or fundamental emotions in mind.

The theorists in the discrete emotion model tradition suggest that during the course of evolution, a number of major adaptive emotional strategies have developed. These are seen to consist of a limited number, generally between seven and 14, of basic or fundamental emotions of which each has its specific eliciting conditions and its specific physiological, expressive, and behavioral reaction patterns. Thus, Plutchik (1980) has proposed a set of basic emotions based on fundamental, phylogenetically continuous classes of motivation as identified by ethological research.

Many of the discrete emotion models are derived from Darwin (1872/1998) who took a number of major emotion terms in the English language as chapter headings and demonstrated for each of these the functionality, the evolutionary history, and the universality across species, ontogenetic states, and different cultures. Tomkins (1962) extended Darwin's theorizing to argue that a number of basic or fundamental emotions could be conceived of as phylogenetically stable neuromotor programs. While Tomkins did not describe the nature of these programs in detail, the assumption was that specific eliciting conditions would automatically trigger a pattern of reactions ranging from peripheral physiological responses to muscular innervation, particularly in the face. Ekman (1984, 1992) and Izard (1971, 1990) extended the theory and attempted to obtain pertinent empirical evidence. Given the limited number of such basic or discrete emotions, theorists in this tradition assume a mechanism of emotion mixing or blending to explain the large variety of emotional states that are distinguished in the language. On the whole, the major theorists in this area have focused mostly on the prototypical reaction patterns (in particular facial expression and physiological responses) that are considered to be characteristic for a particular basic emotion. There has been much less concern with the elicitation and differentiation of the respective emotion, generally thought to be determined by eliciting situations that are again considered to be characteristic for the respective emotion (such as death of a close person in the case of sadness or encountering a severe threat for life or well-being in the case of fear).

There are a number of aspects of discrete emotion theory that make it seem suboptimal to describe the emotional effects of music. Firstly, the small number of primary basic emotions seems ill adapted to describe the extraordinary richness of the emotional effects of music reported in both fictional and scientific accounts. A restriction of that highly differentiated gamut of potential experiences to seven to 14 states constitutes a serious impoverishment and a lack of resolution in the measurement instrument with respect to the phenomenon to be assessed. This is particularly true since emotion blends, as postulated by some theorists in this domain, are virtually never studied in discrete-emotion-based research on the emotional effects of music.

Secondly, according to discrete emotion theory, the elicitation of the basic emotions is due to prototypical situations such as loss, threat, etc. While there is no doubt that in all cultures music often accompanies socially significant events that generate strong emotions, the latter are generally elicited by the nature of the event rather than the music itself. Listening to music for pleasure, one of the prime achievements of human culture can hardly be considered to be comparable to such typical emotion-eliciting events and situations, many of which are considered to reflect similar motivational states across species. In addition, music appreciation in itself could not account for the extraordinary differentiation of emotional effects.

Thirdly, listening to music is unlikely to evoke a limited number of neuromotor programs resulting in highly emotion-specific facial expressions or physiological response patterns. In fact, except for facial expression portrayals by actors, such response specificity is rarely found in laboratory studies of emotional induction (Scherer, 1992). While well-controlled, large scale physiological reaction studies with music listeners in concert halls and operas (or in front of their stereo equipment) remain to be done, it seems rather unlikely that they will produce a limited number of highly specific autonomous response patterns, corresponding to basic emotion profiles, that are shared by the majority of listeners. Common knowledge suggests that listeners in concert halls rarely exhibit facial expressions of strong emotions; generally one observes expressions of impassive, concentration, and sometimes bliss.

Thus there is little evidence that music, at least classical music in its institutionalized form, produces massively shared basic emotions, in the form of emotion-specific profiles of physiological response patterns, motor expressions, and feeling states, in the members of an audience. One could argue that the induction of basic emotions by music is an individual rather than a collective phenomenon, resulting from an interplay between factors in the music, in the individual, and in the situation. Thus Gabrielsson (2001) reports that respondents in the SEM (strong emotions in music) study mentioned emotions like anger, fear, shock, horror,

panic, sadness, mourning as consequences of listening to specific pieces of music. However, it is not always clear, as Gabrielsson points out, whether respondents' verbal description refer to the emotions they actually experienced or their impression of the expressive meaning that the respective musical passage conveyed (see also Gabrielson & Lindström Wik, 2003). In those cases where reference is clearly made to felt emotions, the music often served only as an elicitor of personal memories and associations that, often in a specific situational context, produced or recalled strong emotional experiences. While the power of music to elicit such memories and situations is certainly significant and needs further explanation (see review of the production rules above), it cannot be taken as evidence that certain musical forms will systematically and reliably produce the same types of strong basic emotions in large numbers of listeners with diverse memories and association structures in many different situations, including the concert hall. While some kinds of music, like rock or techno, may well have the potential to induce collective affective phenomena in large groups of people at concerts, it is not clear whether the affective manifestations, including motor behavior, actually induce bona fide emotions and if so, if these are due to the music or the nature and behavior of the musicians. To my knowledge, there is no empirical evidence on this question.

It would seem, then, that discrete emotion models are not the best theoretical basis to study emotional effects of music nor do they provide categories and measurement instruments that are well suited to research in this area. Why is it, then, that the use of basic or fundamental emotion categories is so popular in studies on emotional effects of music? The work of Tomkins, Izard, and Ekman has been responsible for the renaissance of work on emotion in modern psychology which was first dominated by behaviorism and then by cognitivism. Therefore, much of present day emotion psychology is in one way or another strongly influenced by the assumption of discrete fundamental emotions. Obviously, this idea is strongly supported by the existence of verbal labels with very high frequency of usage, such as anger, fear, sadness, and joy, which serve to describe overarching concepts or prototypes.

Many researchers using a list of so-called fundamental emotions in their research may be convinced that this list provides comprehensive and representative coverage of the emotion domain. Given the disagreement as to the number and identity of "basic" emotions (Ortony & Turner, 1990), this is a vain hope, especially since most theorists do not provide credible criteria for including certain emotions in their list. One exception is the list of defining criteria suggested by Ekman (1992), who requires, among other things, that a basic emotion must be very brief (2–3 minutes) and be characterized by a specific, interculturally stable facial expression pattern. It is unlikely that these criteria are optimally suited to describe music-induced affect. Finally, researchers who like to describe their favorite list of basic emotions as the "Big Six" (with the set of six varying over researchers) seem to draw a parallel to the "Big Five" in personality measurement. This constitutes a serious category error, given the major differences in the nature of the underlying domain and in the measurement operations used, as well as the absence of evidence for a single robust factorial structure of emotion terms.

In conclusion, while music making and listening to music certainly have a strong evolutionary basis, and music often plays a major part in social situations that provoke strong emotions, it is unlikely that listening to pieces of classical music in the concert hall or from CD will provoke powerful basic emotions like anger, fear, disgust, or desperation. Since the latter situation is generally studied in this area, a more adequate conceptualization and measurement approach is required.

5.2 Dimensional models of emotion description

Wilhelm Wundt, one of the pioneers of experimental emotion research in the last century, suggested distinguishing between three dimensions of feelings – pleasantness–unpleasantness, rest–activation, and tension–relaxation – to be assessed by introspection. This three-dimensional model has had a strong impact on the psychology of affect and emotion. Since the third dimension has been difficult to establish reliably in an empirical fashion via factor analyses, feeling is often defined in terms of a two-dimensional space formed by valence and activation. Such two-dimensional models have some appeal in that they allow illustrating similarities between different feelings in terms of neighborhood in space (Feldman, Barrett & Russell, 1999). The tendency to lump rest–activation/arousal and tension–relaxation into one single dimension is particularly unfortunate since the latter is an important dimension in musical analysis (see Gabrielson & Juslin, 2001).

The use of two-dimensional valence-activation models has become very widespread in the affective sciences and is well represented in research on emotional effects of music. This approach has some obvious practical advantages. It is simple, easily understood by participants in experiments, and highly reliable. From a theoretical point of view one can argue that activation or arousal variation is one of the major distinctive features of emotion (indeed, Duffy (1941) suggested emotions are just different degrees of arousal), and the valence dimension, the pervasive pleasant–unpleasant quality of experience, maps directly into the classic approach–avoidance action tendencies that have direct relevance for behavior. Recently, Russell (2003) even went as far as claiming that valence and arousal are the "core processes" of affect, constituting the raw material or primitive of emotional experience.

Let us briefly examine the merits of this claim. We first need to distinguish clearly between "emotion" and "feeling". Wundt, who made this distinction, thought of valence, activation, and tension as the underlying dimensions of subjective *feeling*. Thus, the dimensional approach does not address the issue of emotion but only that of feeling. What is the dif-

ference? Feeling is a component, not a synonym, of emotion. Adopting a component process approach to emotion, I have suggested (Scherer, 1984, 2001) that the feeling component can be conceptualized as a reflection of all changes in components during an emotion episode, i.e., the results of event appraisal, motivational change, and proprioceptive feedback from motor expression and physiological reactions. It is important to define differentially the concepts in this fashion as the tendency to use emotion (the process as a whole) and feeling (one of its components) as synonyms results in confusion. Even though the distinction might not be lexically available in some languages (e.g., *känsla* means both in Swedish), the conceptual distinction should be made in theoretical and empirical accounts.

What are the primitives of feeling? Individuals can verbally report a multitude of qualitatively different feelings, as encoded in a rich emotion vocabulary. These internal sensations, often considered as necessarily conscious experiences, are often called *qualia* by philosophers; irreducible qualities of feeling that are unique to the specific emotional experience of a particular individual. I hold that *qualia* are the primitives of feeling because they are the direct reflection of an individual's unique experiences. This view is buttressed by the fact that when one asks people what they have felt during a certain emotional episode, they rarely spontaneously answer in terms of valence and arousal gradation. We asked a representative sample of the Swiss population what emotion they experienced on the previous day. They described the situation and labeled their subjective experience, their feelings, in their own words. Only a very small percentage of the more that 1000 respondents used general negative or positive valence labels (5.8%), and almost none used direct arousal terms (Scherer et al., submitted). Obviously, if we had provided them with scales for pleasantness and activation of the experience, they would have gladly, and reliably, complied.

I submit, then, that it is the *qualia* that constitute the primitives of feeling and that these are extraordinarily rich and varied. The three dimensions that Wundt first identified define the three most important dimensions of the multidimensional space populated by these *qualia* and, as in any multidimensional analysis; objects can be mapped from a many-dimensional space into a two- or three-dimensional space. When we ask people to describe their feelings with respect to pleasantness and arousal, we ask them to perform a mental principal components analysis. In this sense, a dimensional mapping is a secondary, derived representation rather than a primary one or a primitive. Clearly, both representations are valid; they both have advantages and disadvantages. While the description of *qualia* provides a more detailed and richer picture, a two-dimensional representation is economical and allows a direct comparison between individual experiences on the two underlying dimensions. In consequence, it depends on research aims and priorities which approach should be chosen. What solution would be most appropriate to describe the emotional effects of music?

Specifying the quality of a feeling only in terms of valence and activation does not allow a very high degree of differentiation – qualitatively rather different states can be close neighbors in valence-activation space (e.g., panic fear and hot anger). This is particularly important in research on music, where one may expect a somewhat reduced range of both the unpleasantness and the activation of the states produced. In consequence, adopting a valence by activation approach, asking listeners to rate their state on these two dimensions, may not allow a very fine-grained separation of the emotional effects of different pieces of music.

Most importantly, however, a valence by activation approach is entirely descriptive in nature, focusing exclusively on a fairly undifferentiated end result of the entire process. It does not encourage the development of theoretical predictions as to the mechanism underlying the affective functions of music. For example, boredom and melancholy are likely to be close neighbors in the valence-arousal space. In consequence, using a two-dimensional approach would not allow differentiating the musical forms that will produce one rather than the other, nor allow examining the origin and mechanisms of such effects.

In conclusion, valence-activation approaches to describing the emotional effects of music are more realistic than basic emotion approaches because they can appropriately represent a large number of very different emotions. They are reliable and economical, both with respect to application and representation, and they allow direct comparison of different emotions on two standard and important dimensions. However, they also present important drawbacks due to their low degree of resolution and differentiation and the complete absence of explanatory frameworks helping to identify the underlying mechanisms.

5.3 Eclectic approaches to describing music-induced emotions

The discussion so far suggests that the two most popular approaches to studying emotional effects of music, asking listeners to choose between basic emotion labels or rating feeling states on positive–negative/active–passive dimensions are not optimally suited for the task. The third approach regularly encountered in this research area consists of the use of eclectic scales containing verbal affect labels deemed pertinent by a particular researcher for a particular study. Because the whole gamut of emotion labels from natural languages can be used, this approach is much closer to the *qualia* that, in this account, reflect the primitives of the feeling states produced by music, being more likely to represent the immense richness and complexity of affective reactions to this form of art. In addition, there is an added advantage of flexibility – labels can be freely chosen depending on the aim of the study, the nature of the music to be used, the type of listeners recruited, etc.

Unfortunately, this approach also suffers from some serious problems. There is no guarantee that the labels

chosen can be reliably judged, that they cover affective phenomena likely to be produced by music, or that they are organized in an economical, non-redundant manner. Most importantly, they render the comparison of data from different studies or a systematic accumulation of findings impossible.

In the discussion above, the established conceptual and methodological approaches in this area, basic emotion, dimensional, and eclectic approaches, have been found wanting with respect to their ability to help identify and assess the mechanisms that might underlie emotional effects of music in a comprehensive, differentiated, and reliable fashion. A new approach, based on extensive statistical analysis of frequencies and semantic similarities may improve on some of the problems but cannot guarantee comprehensive coverage. What, then, are the alternatives? I submit that it would be most appropriate to base the choice of a measurement instrument on a more comprehensive theoretical basis with respect to the underlying processes. In what follows I outline some elements of such an approach, addressing in particular the issue of conceptually differentiating the affective states that are likely (or not) to be induced by music, the component nature of these states, and the underlying production processes.

6. Alternatives to current methods of measuring music-induced emotions

Given the large number of different affective states that can be induced by music, it seems imperative to develop new methods of examining emotional concomitants of listening to music. Such methods should include objective measurement of the components that have been rarely studied in the past – physiological reaction patterns, body movement, and motor expression (see Scherer & Zentner, 2001). In this contribution the accent has been placed on verbal report of the *subjective feeling component.* Obviously, this remains one of the mainstays of methodology in this area. Given the shortcomings of the traditional methods described above, new approaches would be highly welcome. Some of these problems mentioned above can be remedied by the development and wide-spread adoption of a judgmental rating scale for emotional feeling states that is uniquely adapted to the needs of music research. Such instruments should be developed in a principled rather than an eclectic manner and it should be thoroughly pretested for its psychometric properties.

The Geneva Emotion Research Group, in a project directed by Professor Marcel Zentner, has embarked upon the development of such a scale. This development is essentially driven by an effort to discover which verbal affect labels listeners to music of different types find most appropriate to label the affect state produced by the listening to widely different pieces of music. Starting with a pool of over 500 terms, we are in the process of progressively reducing the eligible terms to a smaller number to obtain a representative set of a realistic size that can be expressed in about eight to 10 factors. In the process, we are examining potential differences in the appropriateness of terms depending on whether the listener has to describe the character of the music, i.e., what is expressed by the music, or the nature of the affective change in feeling that has been produced by the music. We conducted studies in the laboratory, in homes, and at the occasion of public concerts, studying jazz, rock, and pop, in addition to classical music. While the examination of the psychometric qualities of such a new scale is relatively straightforward, its validation is more of a problem. Currently we define two major criteria, (1) the agreement between different listeners to characterize similar pieces with similar scale items, and (2) the ability of the scale items to discriminate different pieces of music in multidimensional space (defined by the fit of higher-order dimensional or cluster analyses and the relative distance of the musical pieces from the cluster centers). We hope to be soon able to suggest such a new scale, constructed according to clearly specified principles, to the research community. If we could convince our colleagues of the utility of such a scale and if, in consequence, it would be widely adopted, two of the major drawbacks in current research efforts could be overcome: (1) the difficulty of comparing results over studies and accumulating findings, and (2) the measurement of emotional feeling dimensions that are uniquely adapted to the effects of music.

Because it is only loosely based on the component process approaches defined above, the approach may seem eclectic. However, since the items are empirically derived, the scale is, in a strict sense, no longer truly eclectic. The categories presented to the listeners have been chosen on the basis of statistical criteria reflecting the semantic domains that are chosen frequently and that show little conceptual overlap. However, the frequency criterion, while obviously of practical importance (economy of time and effort by measuring only frequently occurring events), has the disadvantage of potentially neglecting rare phenomena that are of major importance to understanding the underlying mechanisms. For example, strong fear is a rare emotion (Scherer, 1997; Scherer et al., 2004), yet it is essential to understand the evolutionary functions of emotion with respect to the preparation of adaptive action tendencies. In consequence, a scale that measures emotions induced by music mainly on the basis of a frequency criterion may overlook affective states that will need to be considered in order to understand the phenomenon as a whole.

Given that the scale currently constructed in Geneva is based on principled, but strictly empirical criteria, one may wonder to what extent it can inform the search for mechanisms. While we are not sufficiently advanced in the development of the new instrument, I can suggest some preliminary observations. First, the restricted set of affect labels that survives our rigorous selection procedure includes many different types of affect descriptions. Many of these reflect the fact that, as theoretically argued above, feeling states can be considered as reflecting the changes in all com-

ponents of an emotion episode by making reference to cognitive (nostalgic), physiological (tense), or motivational, action-related (feeling like wanting to dance) components. This can be explained by the fact that the basis for the verbal labeling of emotional states consists of the changes in conscious subjective feeling states. While this feeling component may reflect the changes characterizing an emotion process in all of the organismic subsystems, verbal labels often represent only a salient part of those changes, those that reach awareness (Scherer, 2001). In many cases this process of becoming aware of a change and labeling it may be restricted or give prominence to individual emotion components. For example, the term "tense" which is frequently used as an affect descriptor seems to refer almost exclusively to a special tonic state of the somatic nervous system, the striated musculature.

Second, many of the terms are reminiscent of the potential mechanisms underlying affect induction through music that we have called *production rules*. We suggested that music can induce emotion via a central route including appraisal: memory associations, or empathy, and via a peripheral route, for example via proprioceptive feedback. Thus, some of the words in our final list of candidates (e.g., filled with wonder or feeling transcended) suggest new criteria for appraisal, especially with respect to the appraisal of intrinsic aesthetic qualities and of levels of reality. Others (like nostalgic or affectionate) suggest memory associations to places or relationships. Still others (such as comforted) may be linked to processes of empathy. The peripheral route consists of mechanisms which are based on motor induction of peripheral arousal (e.g., sympathetic changes via rhythm or action tendency induction) and a change of feeling state due to consequent proprioceptive feedback. Terms like "feeling like dancing", feeling energetic or strong but also calm suggest this type of mechanism. In consequence, using the criterion of what listeners find most appropriate as labels to describe emotional effects of music listening seem to provide promising leads for the inquiry into the underlying mechanisms than established basic emotion lists or valence-activation dimensions.

7. Conclusions

The study of emotional effects of music, informed by many centuries of speculation on the issue, is likely to continue to thrive. It is essential that researchers in this area realize the complexity of the underlying issues and attempt to develop and choose research instruments that are up to the task, rather than choosing convenience or tradition. Many of the established techniques have serious shortcomings, as shown above.

Inappropriate measurement instruments not only carry the danger of missing essential aspects of the phenomenon or obtaining biased data, they also prevent accumulation and comparability of results in a domain that critically depends on coordinated efforts for its further development.

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References

Bartlett, D.L. (1999). Physiological responses to music and sound stimuli. In: D.A. Hodges (Ed.), *Handbook of Music Psychology*, 2nd edn. San Antonio, TX: IMR: 343–385.

Byers, P. (1976). Biological rhythms as information channels in interpersonal communication behavior. In: P.P.G. Bateson, & P.H. Klopfer (Eds.), *Perspectives in Ethology*, Vol. 2. New York and London: Plenum: 135–164.

Boiten, F.A., Frijda, N.H., & Wientjes, C.J.E. (1994). Emotions and respiratory patterns: Review and critical analysis. *International Journal of Psychophysiology*, *17*, 103–128.

Dalgleish, T., & Power, M.J. (Eds.) (1999). *Handbook of Cognition and Emotion*. Chichester: Wiley.

Darwin, C. (1872). *The expression of emotions in man and animals*, 3rd edn. P. Ekman (Ed.). London: HarperCollins, 1998.

Duffy, E. (1941). An explanation of "emotional" phenomena without the use of the concept "emotion". *Journal of General Psychology*, *25*, 283–293.

Ekman, P. (1984). Expression and the nature of emotion. In: K.R. Scherer, & P. Ekman (Eds.), *Approaches to Emotion* Hillsdale, NJ: Erlbaum: 319–344.

Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion*, *6*, 169–200.

Ekman, P. (1994). Strong evidence for universals in facial expressions: A reply to Russell's mistaken critique. *Psychological Bulletin*, *115*, 268–287.

Ekman, P., Levenson, R.W., & Friesen, W.V. (1983). Autonomic nervous system activity distinguishes among emotions. *Science*, *221*, 1208–1210.

Feldman Barrett, L., & Russell, J.A. (1999).The structure of current affect: Controversies and emerging consensus. *Current Directions in Psychological Science*, *8*, 10–14.

Farnsworth, P.R. (1969). *The Social Psychology of Music*, 2nd edn. Ames, IA: Iowa State University Press.

Frijda, N.H. (1986). *The Emotions*. Cambridge and New York: Cambridge University Press.

Gabrielsson, A. (2001). Emotions in strong experiences with music. In: P.N. Juslin, & J.A. Sloboda (Eds), *Music and Emotion: Theory and Research*, Oxford: Oxford University Press: 431–452.

Gabrielsson, A., & Juslin, P.N. (2003). Emotional expression in music. In: R.J. Davidson, K.R. Scherer, & H.H. Goldsmith, (Eds.), *Handbook of Affective Sciences*, New York: Oxford University Press: 503–534.

Gabrielsson, A., & Lindström Wik, S. (2003). Strong experiences related to music: A descriptive system. *Musicae Scientia*, *7*, 157–217.

Goffman, E. (1959). *The Presentation of Self in Everyday Life*. Garden City, NY: Doubleday Anchor.

Goffman, E. (1971). *Relations in Public: Microstudies in the Public Order*. New York: Basic Books.

Hochschild, A.R. (1983). *The Managed Heart: The Commercialization of Human Feeling*. Berkeley, CA: University of California Press.

Izard, C.E. (1971). *The Face of Emotion*. New York: Appleton-Century-Crofts.

Izard, C.E. (1990). Facial expression and the regulation of emotions. *Journal of Personality and Social Psychology*, *58*, 487–498.

Juslin, P.N., & Sloboda, J.A. (Eds.) (2001). *Music and Emotion: Theory and Research*. Oxford: Oxford University Press.

Jürgens, U. (1988). Central control of monkey calls. In: D. Todt, P. Goedeking, & D. Symmes (Eds.), *Primate Vocal Communication*, Berlin, Germany: Springer: 162–170.

Kant, I. (2001). *Kritik der Urteilskraft.* Hamburg: Meiner.

Kenyon, N. (Ed.) (1991). *Authenticity and Early Music*. Oxford: Oxford University Press.

Lazarus, R.S. (1991). *Emotion and Adaptation*. New York: Oxford University Press.

LeDoux, J.E. (1992). Emotion as memory: Anatomical systems underlying indelible neural traces. In: S. Christianson (Ed.), *Handbook of Emotion and Memory: Theory and research*. Hillsdale, NJ: Erlbaum.

Leventhal, H., & Scherer, K.R. (1987). The relationship of emotion to cognition: A functional approach to a semantic controversy. *Cognition and Emotion*, *1*, 3–28.

McIntosh, D.N. (1996). Facial feedback hypotheses: Evidence, implications, and directions. *Motivation and Emotion*, *20*, 121–147.

Öhman, A. (1988). Preattentive processes in the generation of emotions. In: V. Hamilton, G.H. Bower, & N.H. Frijda (Eds.), *Cognitive Perspectives on Emotion and Motivation*, Dordrecht: Kluwer Academic Publishers: 127–144.

Ortony, A., & Turner, T.J. (1990). What's basic about basic emotions? *Psychological Review*, *97*, 315–331.

Plutchik, R. (1980). *Emotion: A Psychobioevolutionary Synthesis*. New York: Harper & Row.

Rahn, J. (Ed.) (1994). *Perspectives on Muscial Aesthetics.* New York: W.W. Norton.

Scruton, R. (1997). *The Aesthetics of Music*. Oxford: Oxford University Press.

Russell, J.A. (1994). Is there universal recognition of emotion from facial expression? A review of the cross-cultural studies. *Psychological Bulletin*, *115*, 102–141.

Russell, J.A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, *110*, 145–172.

Scherer, K.R. (1984). On the nature and function of emotion: A component process approach. In: K.R. Scherer, & P. Ekman (Eds.), *Approaches to Emotion*, Hillsdale, NJ: Erlbaum: 293–317.

Scherer, K.R. (1992). What does facial expression express? In: K. Strongman (Ed.), *International Review of Studies on Emotion*. Vol. 2, Chichester: Wiley: 139–165.

Scherer, K.R. (1994). Toward a concept of "modal emotions". In: P. Ekman, & R.J. Davidson (Eds.), *The Nature of Emotion: Fundamental Questions*, New York/Oxford: Oxford University Press: 25–31.

Scherer, K.R. (1997). Profiles of emotion-antecedent appraisal: testing theoretical predictions across cultures. *Cognition and Emotion*, *11*, 113–150.

Scherer, K.R. (1999). Appraisal theories. In: T. Dalgleish, & M. Power (Eds.). *Handbook of Cognition and Emotion*, Chichester: Wiley: 637–663.

Scherer, K.R. (2000). Psychological models of emotion. In: J. Borod (Ed.), *The Neuropsychology of Emotion*, Oxford/New York: Oxford University Press: 137–162.

Scherer, K.R. (2001). Appraisal considered as a process of multi-level sequential checking. In: K.R. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal Processes in Emotion: Theory, Methods, Research*, New York and Oxford: Oxford University Press: 92–120.

Scherer, K.R., Wranik, T., Sangsue, J., Tran, V., & Scherer, U. (2004). Emotions in everyday life: Probability of occurrence, risk factors, appraisal, and reaction patterns. *Social Science Information*, *43*(4), 499–570.

Scherer, K.R., Schorr, A., & Johnstone, T. (Eds.) (2001). *Appraisal Processes in Emotion: Theory, Methods, Research*. New York and Oxford: Oxford University Press.

Scherer, K.R., & Zentner, K.R. (2001). Emotional effects of music: production rules. In: P.N. Juslin, & J.A. Sloboda (Eds.), *Music and Emotion: Theory and Research*, Oxford: Oxford University Press: 361–392.

Scherer, K.R., Zentner, M.R., & Schacht, A. (2002). Emotional states generated by music: A exploratory study of music experts. *Musicae Scientiae. The Journal of the European Society for the Cognitive Sciences of Music* (*Special issue*), 149–171.

Stemmler, G. (2004). Physiological processes during emotion. In: R.S. Feldman, & P. Philippot (Eds.), *The regulation of emotion*, Mahwah, NJ: Erlbaum: 33–70.

Tarrant, M.A., Manfredo, M.J., & Driver, B.L. (1994). Recollections of outdoor recreation experiences: A psychophysiological perspective. *Journal of Leisure Research*, *26*, 357–371

Tomkins, S.S. (1962). *Affect, Imagery, Consciousness: Vol. 1. The Positive Affects*. New York: Springer.

van Reekum, C.M., & Scherer, K.R. (1998). Levels of processing for emotion-antecedent appraisal. In: G. Matthews (Ed.), *Cognitive Science Perspectives on Personality and Emotion*, Amsterdam: Elsevier Science: 259–300.

Zentner, M.R. (2000, August). Exploring musical emotions across five genres of music. Paper presented in the Symposium "Current Trends in the Study of Music and Emotion" (P.N. Juslin, & M.R. Zentner, Chairs). 6th Conference of the Int. Society for Music Perception and Cognition (IMPC), Keele (UK).