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Chapter 5

From mimesis to catharsis: expression, perception, and induction of emotion in music

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Musical communication is often considered to be a transmission process through which meaning of some kind is conveyed from one person to another. Opinions vary drastically on the nature of the meaning, and on exactly 'who' or 'what' is doing the conveying. However, as pointed out by Meyer (1956) and Serafine (1980), the meaning–transmission idea is also evoked by formalists, who implicitly assume that there is some meaning to be received or 'decoded' by a listener. The question is: What does music communicate? Although this book provides a number of different answers to this question, probably the most common notion about what music communicates is emotion. Music is often referred to as 'the language of emotions' (e.g. Cooke 1959). This idea is not entirely accurate (there is not a semantics in music), but it does capture one important feature, namely that music is often seen as an effective means of expressing and inducing emotions:

> 'Nearly everyone enjoys listening to music. Why? Undoubtedly, because music moves the emotions. But this answer replaces one puzzle with two: how does music communicate emotions, and why do we enjoy having our emotions stirred in this way? No one knows...'
>
> (Johnson-Laird 1992, p. 13)

Johnson-Laird's final sentence is perhaps overly pessimistic. As we shall see later in this chapter, researchers are making *some* progress, at least, in explaining how music communicates emotions to listeners (see also Juslin and Sloboda 2001).

This chapter aims to provide a review of important theoretical concepts as well as empirical findings regarding musical emotions that may serve as a background to some of the following chapters of this volume, several of which touch upon emotional aspects of musical communication. Because it is sometimes hard to clearly distinguish instances of communication from

instances of non-communication in regard to musical emotions – and because researchers often disagree about how emotional communication should be defined – I will deliberately cast a wide net on research on musical emotions that can help us understand musical communication. This will pave the way for a serious consideration of whether music really can be conceived of as a channel of emotional communication. The so-called 'transmission model' of music has been criticized by some authors (Swanwick 1985). This chapter might be construed as an attempt to convince a skeptic that there *is* a sense in which music communicates emotions to listeners – which is *not* to say that this is the sole or main value of music (Budd 1989).

The structure of this chapter is as follows: First, I critically examine the notion of music as a means of communication of emotion, and present some relevant evidence concerning this issue. Then, I provide a working definition of emotions and some conceptual distinctions for the study of musical emotion. Following that, I review mechanisms through which music may express and induce emotions, respectively. Finally, I consider various objections to music-as-communication and provide an agenda for future research. The discussion is generally limited to Western music, especially classical and popular music from the eighteenth century to present day.

Music as communication of emotion

Working definition of communication

Johnson-Laird (1992) offers a useful working definition of communication. First, he notes that communication is a matter of *causal influence*; that is, a communicator influences his or her recipient, one way or another (e.g. a musician influences the auditory impressions of a listener). However, Johnson-Laird notes that the concept of communication also calls for something more: a communicator has a *message* to transmit. Specifically, the communicator constructs an internal representation of some aspect of the world, such as an emotional state, and then – *intentionally* – carries out some symbolic behaviour that conveys the content of that representation. The recipient must first perceive this symbolic behaviour, and then recover from it an internal representation of the content it signifies. Like all symbolic behaviours, the communicative behaviour is arbitrary in at least one sense: different symbolic conventions could, in principle, have been used to convey the same contents. Yet, in any concrete instance of communication, the symbolic behaviour used may reflect natural principles, human conventions, or a combination of the two. The important thing is that there is a shared 'code' among senders and receivers (Shannon and Weaver 1949).

Communication in music

Application of the aforementioned definition of communication to music requires that we clarify the relationship between expression and communication. Figure 1 illustrates the 'chain' of musical communication as it is commonly conceived by music researchers, and may help us to compare various definitions of expression and communication. Moving from left to right, Fig. 5.1 shows (1) the composer's intention (e.g. the notation); (2) the performer's intention; (3) the acoustic features of the music; (4) the listener's perception of these features (involving both the detection of the features and the recognition of relevant patterns in them); and (5) the (possible) induction of mental states as an effect of this perception. Each of these aspects is, of course, embedded in a particular context, but the context is rarely modelled explicitly.

It is important to note that different definitions of expression and communication focus on different aspects. Particularly, they differ with regard to how many of these aspects are required in order for a particular instance to qualify as a case of 'expression' or 'communication'. It may seem natural to include *all* of the aspects in any definition of expression or communication, but this is seldom done explicitly, or in actual practice. More often, only sub-sets of the aspects are taken into account. The most extreme example is provided by researchers of expression in music performance, who often define 'expression' simply in terms of the large and small variations in timing, dynamics, timbre, and pitch that form the *microstructure* of a performance (e.g. Palmer 1997).

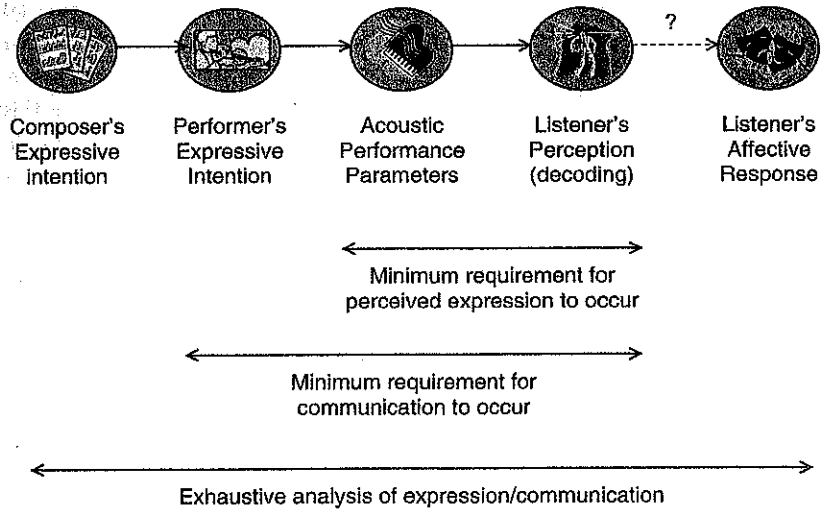

Fig. 5.1 Different aspects of the chain of musical communication of emotion.

This view implies that acoustic features alone are sufficient to define musical expression. This notion is problematic, however. Although musical expression originates in performers' and composers' behaviours, it is more appropriate to define expression from the listener's perspective: 'Expression's domain is the mind of the listener' (Kendall and Carterette 1990, p. 131).

In this chapter, *expression* refers to a set of perceptual qualities (e.g. structural, emotional, motional) that reflect psycho–physical relationships between 'objective' properties of the music, and 'subjective' – or, rather, objective but partly person-dependent – impressions of the listener. Expression does not reside solely in the acoustic properties of the music (different listeners *may* perceive the expression differently), nor does it reside solely in the mind of the listener (different listeners *usually* agree about the general nature of the expression in a piece of music). Expression depends on both of these factors, in ways that, although complex, can be modelled in a systematic fashion (see Juslin 2000). Our perception of expressive music reminds us, somehow, of the ways humans express their states of mind in real life; why would we otherwise use the term expression in the first place? We have a tendency to perceive *expressive form* even in inanimate objects. For instance, a tree may be sad-looking (e.g. Davies 1994). Sometimes, the perception of expressive music also evokes an *emotion* in the listener (he or she is 'moved'), though such a response is not *required* for a listener to hear the music as expressive (Davies 1994). Musical expression is often measured in terms of *listener agreement*: music is expressive of a certain quality to the extent that there is some level of agreement among listeners about the expression (presumably because there is something in the actual music that gives rise to similar listener impressions). Though studies of expression may well benefit from analyses of composers' or performers' intentions, perception of expression – as defined here – does not require that there is an expressive intention on the part of the composer or performer (Juslin 2003).

The concept of *musical communication* (of emotion for instance), in contrast, goes further: Communication, I propose, requires that there is both a composer's (or performer's) *intention* to express a specific concept and *recognition* of the same concept by a listener. The accuracy of the communication may be indexed in terms of the extent to which the composer (or performer) and the listener agree about the expression of the music: is the expression perceived as intended? That a definition of communication should include the composer's intention, the performer's intention, the acoustic features of the music, and the listener's perception is, perhaps, not controversial. The critical question is whether communication requires that the music, in addition, *induces* emotions in the listener (cf. Fig. 5.1). A review of the literature reveals that different authors have used the concept of emotional communication differently.

Some authors view communication in terms of perception (e.g. Juslin 1997*a*; Thompson and Robitaille 1992); that is, emotions are expressed by musicians and perceived by listeners – induction is 'optional'. Other authors limit the concept to instances where the emotion expressed is also *induced* in the listener. Both uses of the term could be legitimate, depending on the circumstances. Therefore, in this chapter, I shall review empirical findings regarding both perception and induction of emotions.

Does music communicate emotions?

Although some readers might find it obvious that music communicates emotions, this notion has been questioned by certain authors (Hanslick 1854/1986). On what basis can we really claim that music involves emotional communication? A natural point of departure is to consult listeners and musicians. Studies of popular music have revealed that listeners emphasize the role of music-as-communication: 'Popular musicians are loved, and even worshipped, not only for their abilities to write songs and perform them publicly, but for their ability to "speak" to their audiences. Even an artist whose only contact with the audience is through the sales of millions of compact discs and tapes communicates "personally" with each listener' (Lull 1992, p. 3). Such an impression is confirmed by recent findings from a questionnaire study featuring 141 listeners, aged 17–74, who responded to various questions about musical expression, communication, and emotion (Juslin and Laukka 2004). The majority of listeners (>67 per cent) reported (a) that they experience that music (or musicians) communicates with them, and (b) that music communicates emotions (as indicated by their own free responses to an open-ended question). All of the listeners believed that music can express emotions (as compared to, for instance, 51 per cent for 'personality characteristics') and 76 per cent of the listeners claimed that music expresses emotions 'often'.

Similarly, a questionnaire study featuring 135 expert musicians from three countries (England, Italy, Sweden) revealed that the majority of the musicians defined expression mainly in terms of 'communicating emotions' and 'playing with feeling' – as indicated by their own free responses (Lindström *et al.* 2003). When directly asked about whether music expresses emotions, 99 per cent of the musicians confirmed that this is the case. Moreover, 83 per cent of the musicians claimed that they try to express specific emotions in their musical performances 'always' or 'often'. These results are confirmed and extended in recent research by Minassian *et al.* (2003). They conducted a questionnaire study featuring 53 expert performers of classical music, and explored which factors were statistically associated with an optimal performance. Performances judged as optimal tended to be those where the performer (a) had a clear

intention to communicate (usually an emotional message), (b) was emotionally engaged with the music, and (c) believed the message had been 'received' by the audience. Finally, an interview study by Burland and Davidson (2004) showed that performers in pursuit of a professional performing career were more inclined to think of music as a vehicle for communication than were performers in pursuit of a non-music career.

Numerous biographies and interviews with performers (both classical and popular) confirm that they often conceive of musical expression in terms of emotions and communication (Boyd and George-Warren 1992; Carreras 1991; Denski 1992; Menuhin 1996; King 1996; Persson 2001; Schumacher 1995). Apart from the fact that listeners and musicians appear to conceive of music in terms of emotional communication, there is also evidence that music really *can* communicate emotions to listeners. The following sections will be devoted to reviewing this evidence.

Key distinctions in musical emotion

The study of musical emotion has generally suffered from conceptual confusion. To enhance the cumulativeness of research efforts, and to promote fruitful debate, it may be heuristic to adopt a number of conceptual distinctions. These distinctions may help researchers to specify in a much more precise fashion *what* they are investigating and *how*. First, we need a working definition of emotion. There are many different ways to define emotions, but most emotion researchers would probably agree that emotions can be seen as relatively brief and intense reactions to goal-relevant changes in the environment that consist of many *sub-components* (Oatley and Jenkins 1996, Ch. 4):

- cognitive appraisal (e.g. you appraise the situation as 'dangerous')
- subjective feeling (e.g. you feel afraid)
- physiological arousal (e.g. your heart starts pounding)
- emotional expression (e.g. you scream and call out for help)
- action tendency (e.g. you are strongly inclined to run away)
- emotion regulation (e.g. you try to calm yourself)

Different researchers of musical emotion focus on different components, as these enter into the musical communication process. For instance, some focus on the emotional expression of the performance; others focus on the cognitive appraisal of the music that induces an emotion, or on how the induced emotion influences physiological measures; still others focus on how music may be used to regulate emotions. It is important to note that what counts for one emotion component, theoretically and empirically speaking, does not necessarily hold for another component.

Researchers disagree as to whether emotions are best conceptualized as *categories* (Ekman 1999), *dimensions* (Russell 1980), or *prototypes* (Shaver *et al.* 1987). Different theories of emotion have been adopted in studies of music, and it is fair to say that there is currently no theoretical paradigm that dominates studies of emotion in music. Most researchers have not explicitly adopted one or the other of these approaches, but their implicit orientation can still be inferred from the way in which they have operationalized listener responses. For example, the researcher who asks the participants to respond by choosing an emotion from a list of emotion labels is implicitly assuming that there are discrete emotion categories.

There are also different *sources* of emotion in music (Sloboda and Juslin 2001); that is, there are different 'psychological mechanisms' that may give rise to emotional responses through their interactions with music (see pp. 102–4 for some examples). Note that what counts for one particular source of emotion may not count for another source, and different theories may be required to explain each source. Furthermore, different sources of emotion may involve and be affected by a number of *causal variables*. Indeed, a serious problem is the manifold determinants of musical emotions. Gutheil (1952, Appendix A) listed, in a systematic fashion, all the variables that might potentially influence musical emotions, and this list may be unprecedented to this day. Given this complexity – later more concisely formulated as *an interaction between the music, the person, and the situation* (e.g. Jørgensen 1988; see also Gabrielsson 2001) – it is important that researchers are careful in how they select causal variables to include in their study.

Finally, it is important to make a distinction between *perception* and *induction* of emotions. We may simply perceive emotions in the music, or we may actually feel emotions in response to the music. This distinction, known since ancient Greece, is often but not always made in modern research. It is crucial to make this distinction for three reasons. First, the underlying mechanisms may be very different depending on the process involved. Second, measuring induced emotion is more difficult than measuring perceived emotion, and the methods must be adapted accordingly. Third, the types of emotions typically expressed and perceived in music could be rather different from the set of emotions typically induced by music.

Mechanisms of musical communication of emotion

Human communication commonly begins and ends with conscious messages. However, the intervening mental processes are almost completely unconscious (Johnson-Laird 1992). Indeed, the fact that many of the processes that underlie musical communication of emotion are implicit helps to 'mystify' the nature of musical expression to musicians (e.g. Denski 1992). However, a large

number of studies have studied the mechanisms by which music communicates emotions to listeners. In the following overview, I adopt the previously noted distinction between perception and induction of emotion. This division must not be taken to imply that the two processes never occur together. On the contrary, they *do* co-occur, although perhaps not always in the simple one-to-one relationship (e.g. 'perception of sadness induces sadness') one may be tempted to believe.

Expression and perception of emotion

Can music express specific emotions? Emotion perception is relatively easy to measure and is a 'cognitive' process in the sense that it may well proceed without any emotional involvement on the part of the listener. In principle, a listener might perceive *any* emotion in a piece of music, and in a sense, it may be inappropriate to claim that the listener is 'wrong'. However, researchers are usually interested in cases where emotions in music are perceived *similarly* by many listeners (or perceived in the way *intended* by a composer or a performer), perhaps because such common impressions relate strongly to the nature of the music. Can music express various emotions in this way? This issue has been examined in terms of (a) *listener agreement* (where the music is said to express a particular emotion 'reliably' when there is a certain level of agreement among listeners about what the music expresses) and (b) *accuracy* (which refers to listeners' 'correct' recognition of emotional expression according to some 'independent criterion' such as the composer's or the performer's intention). The latter index corresponds better to the established meaning of the word communication, although most previous research has relied on measures of agreement, because it is usually difficult to obtain reliable indices of composers' expressive intentions. It can be argued that listener agreement is a necessary but not sufficient condition for communication to occur, in that a performer can hardly be described as successful in communicating a particular emotion to a group of listeners if the listeners totally disagree about the emotion expressed. On the other hand, even if there *is* listener agreement, listeners' judgements may not correspond with the performer's expressive intention, in which case the communicative process is still unsuccessful.

The results from over a hundred studies have suggested that listeners are generally consistent in their judgements of emotional expression in music. That is, listeners' judgements are systematic and reliable, and can thus be predicted with reasonable accuracy. However, there is usually high agreement among listeners about the *broad* emotional category expressed by the music, but less agreement concerning the nuances *within* this category (Campbell 1942; Downey 1897; Juslin 1997*c*). Hence, the precision with which music can convey different emotions is clearly limited. Listeners' agreement about the perceived expression varies depending on many factors (e.g. the piece of music, the musical style, the response format, the procedure), yet perception of emotions in music is robust in that listener judgements are only marginally affected by musical training, age, and gender of the listener (e.g. Gabrielsson and Juslin 2003). That musical training is not required to express (Yamasaki 2002) or recognize (Juslin 1997*a*) emotions in music suggests that general mechanisms of perception of emotion are involved – a hypothesis that is supported by the finding that abilities to decode emotions in music are correlated with measures of *emotional intelligence* (Resnicow *et al.* 2004).

Most studies have focused on discrete emotions. Attempts to reduce perceived emotions to a smaller number of dimensions have typically yielded dimensions corresponding to those obtained in other domains of emotion, such as *activation*, *valence*, and *potency* (Kleinen 1968; Nielzén and Cesarec 1981; Wedin 1972), but also some dimensions that probably are more typical for music (e.g. *solemnity*), and that might reflect a distinction between 'serious' and 'popular' music in the music excerpts used. Much of music's expressiveness lies in the *changes* in musical features over time, and a dimensional approach may be particularly suitable for describing gradual movements of the musical expression in the 'affective space'. Thus, there has recently been some progress in tracing listeners' perception of emotions in music over time, using 'continuous response formats' (Schubert 1999; Sloboda and Lehmann 2001). One interesting development is the use of synthetic facial expressions to display changes in perceived valence and activation (Schubert 2004).

However, while generally attractive, two-dimensional models of perception of emotion have certain problems associated with them. One such problem is that positive and negative affect may be two, partly independent dimensions (Cacioppo and Gardner 1999). If this is true, certain states cannot be properly represented by a two-dimensional space with a single 'valence' dimension. In addition, two dimensions may not adequately differentiate some emotions such as anger and fear that occupy a similar position in the affective space, but that really sound and feel very differently with respect to music. Therefore, findings obtained with continuous response formats need to be corroborated using other response formats (for an example, see Schubert 1999).

Knowledge gained from experimental studies of emotional expression is complemented by information gained from more 'impressionistic' studies of expression, for example, in sociology (Harris and Sandresky 1985; Middleton 1990), musicology (Cook and Dibben 2001), philosophy (Davies 1994), and psychoanalysis (Noy 1993). Freed from the constraints of operationalization (i.e. the translation of theoretical concepts into concretely defined measures)

researchers are able to address more subtle and complex aspects of musical expression, although obviously with more uncertainty regarding the underlying causal relationships.

That listeners tend to agree about the emotional expression in music is one thing, but to what extent can music composers and performers actually *communicate* specific emotions to listeners? Few studies have explicitly investigated the extent to which composers can communicate specific emotions to listeners. However, a rare exception is the study by Thompson and Robitaille (1992). They asked five highly experienced musicians to compose short melodies that should convey six emotions: joy, sorrow, excitement, dullness, anger, and peace. They were required to rely on such information (pitch, temporal and loudness information) that is contained in musical scores. Deadpan performances of the resulting compositions by a computer sequencer were played to fourteen listeners moderately trained in music. They successfully recognized the intended emotions in the pieces. Thus, it would seem that music composers can really convey *some* emotions reliably.

Several studies have investigated the extent to which *performers* can communicate emotions to listeners. These studies have provided fairly precise estimates of the communication accuracy. In the most extensive review of emotional expression in music performance to date (see Juslin and Laukka 2003) including 41 studies, a meta-analysis of the communication accuracy showed that professional performers are able to communicate five emotions (happiness, anger, sadness, fear, tenderness) to listeners with an accuracy approximately as high as in facial and vocal expression of emotions. The overall decoding accuracy was equivalent to a raw accuracy score of $p_c = .70$ in a forced-choice task with five response alternatives (i.e. the mean number of emotions included in studies thus far). In accordance with what has been found in studies that use listener agreement as the dependent variable (as mentioned earlier), the evidence from performance research indicates that the communication process operates in terms of broad emotion categories, whereas finer distinctions within these categories are difficult to communicate reliably without additional context provided by, for instance, lyrics, program notes, or visual impressions.

What are the reasons for music's inability to communicate more specific emotions reliably? There are, in fact, several reasons: first of all, music's ability to communicate emotions is heavily dependent on its similarity to other forms of non-verbal communication and the kinds of emotions that are possible to communicate through *those* channels (cf. Clynes 1977; Davies 1994; Juslin 1997*a*); for instance, the patterns of communication accuracy for various basic emotions in music seem to closely mirror those of emotional speech (Juslin and Laukka 2003). Secondly, the musical features involved in communication of

emotions are only *probabilistically* related to the emotions and are partly *redundant* (e.g. Juslin 2001), which limits the complexity of the information that can be conveyed (Shannon and Weaver 1949). Finally, because precision of communication is not the only criterion by which we value music, communicative reliability is frequently compromised for the sake of other virtues of music, such as beauty of form. Thus, for instance, emotion may be only one of many components of expression in music performance (Juslin 2003; Juslin *et al.* 2002).

How does music express different emotions? There are numerous features of music that have been reported to be suggestive of discrete emotions. Table 5.1 shows an updated summary of these features for the most commonly studied emotions. As can be seen in Table 5.1, the features include tempo, mode, harmony, tonality, pitch, micro-intonation, contour, interval, rhythm, sound level, timbre, timing, articulation, accents on specific notes, tone attacks and decays, and vibrato. Note that there are *different configurations of musical features for different emotions* as predicted by a categorical approach to emotion. Note also that the same feature can be used in a similar manner in more than just one emotional expression (e.g. fast tempo is used in both anger and happiness). Hence, each feature is neither necessary nor sufficient, but the larger the number of features used, the more reliable the communication (e.g. Juslin 2001). The relationships between features and emotions are only *probabilistic* (i.e. uncertain) and are therefore best thought of as correlational, as captured by the *Lens Model* (Juslin 1995). Most of the investigated features are rather simple, whereas more complex features (e.g. harmonic progression, melody, musical form) remain to be thoroughly investigated in future research. In addition to the overall features described in Table 5.1, there are several kinds of *musical ornaments* (e.g. the trill, the appoggiatura) that may be used to express emotions, as discussed in many treatises on interpretation (e.g. Bach 1778/1985) and as also demonstrated in recent research (Timmers and Ashley 2004).

What are the *origins* of these relationships between musical features and different emotions? There is no simple answer to this question, but the relationships most likely have several origins. Performance features such as tempo, loudness, and timbre, many of which music has in common with the non-verbal aspects of speech (Juslin and Laukka 2001), may largely reflect a speech code. We recently made a systematic comparison of 104 studies of emotional speech and 41 studies of emotion in music performance (Juslin and Laukka 2003). Results showed among other things that performers use primarily the same emotion-specific patterns of acoustic parameters that are used in emotional speech (as originally argued by Spencer 1857). This is one example of cross-modal similarities in expressive form between different non-verbal communication channels, which has been suggested by several authors (e.g. Clynes 1977; human movement is

Table 5.1 Summary of musical features correlated with discrete emotions in musical expression

Emotion	Musical features
Happiness	fast tempo, small tempo variability, major mode, simple and consonant harmony, medium-high sound level, small sound level variability, high pitch, much pitch variability, wide pitch range, ascending pitch, perfect 4th and 5th intervals, rising micro intonation, raised singer's formant, staccato articulation, large articulation variability, smooth and fluent rhythm, bright timbre, fast tone attacks, small timing variability, sharp contrasts between 'long' and 'short' notes, medium-fast vibrato rate, medium vibrato extent, micro-structural regularity
Sadness	slow tempo, minor mode, dissonance, low sound level, moderate sound level variability, low pitch, narrow pitch range, descending pitch, 'flat' (or falling) intonation, small intervals (e.g. minor 2nd), lowered singer's formant, legato articulation, small articulation variability, dull timbre, slow tone attacks, large timing variability (e.g. rubato), soft contrasts between 'long' and 'short' notes, pauses, slow vibrato, small vibrato extent, ritardando, micro-structural irregularity
Anger	fast tempo, small tempo variability, minor mode, atonality, dissonance, high sound level, small loudness variability, high pitch, small pitch variability, ascending pitch, major 7th and augmented 4th intervals, raised singer's formant, staccato articulation, moderate articulation variability, complex rhythm, sudden rhythmic changes (e.g. syncopations), sharp timbre, spectral noise, fast tone attacks/decays, small timing variability, accents on tonally unstable notes, sharp contrasts between 'long' and 'short' notes, accelerando, medium-fast vibrato rate, large vibrato extent, micro-structural irregularity
Fear	fast tempo, large tempo variability, minor mode, dissonance, low sound level, large sound level variability, rapid changes in sound level, high pitch, ascending pitch, wide pitch range, large pitch contrasts, staccato articulation, large articulation variability, jerky rhythms, soft timbre, very large timing variability, pauses, soft tone attacks, fast vibrato rate, small vibrato extent, micro-structural irregularity
Tenderness	slow tempo, major mode, consonance, medium-low sound level, small sound level variability, low pitch, fairly narrow pitch range, lowered singer's formant, legato articulation, small articulation variability, slow tone attacks, soft timbre, moderate timing variability, soft contrasts between long and short notes, accents on tonally stable notes, medium fast vibrato, small vibrato extent, micro-structural regularity

Note. Shown are the most common findings in the literature. For further details, see Gabrielsson and Juslin (2003), Juslin and Laukka (2003), and Juslin and Lindström (2003).

another candidate for explaining musical expressiveness, e.g. Davies 1994). Speech prosody may also help to explain some of the emotional connotations associated with melodic contours (e.g. Fónagy and Magdics 1963; Papoušek 1996), which seem to play an important role in the early interactions of infants and caregivers. Various other aspects of composed musical structure are not as easily explained. However, features of a piece of music that are usually indicated in the notation of the piece (e.g. harmony, tonality, melodic progression) are likely to reflect to a larger extent characteristics of music as a human art form that follows its own intrinsic rules and that varies from one culture to another. Some of the effects of composer-features (e.g. consonance/dissonance) may originate in psycho-physical relations between acoustic properties and basic perceptual mechanisms (Cooke 1959), but most probably reflect cultural conventions developed over the long course of music's history, and are in that sense more or less 'arbitrary'. At this stage of the historical development, these alternative but not mutually exclusive explanations are not easily teased apart.

Do we have sufficient knowledge about emotional expression in music to be able to actually model the communication process mathematically? Indeed, there have been successful attempts at *quantifying* various aspects of the emotional communication process, using a modified version of Brunswik's *Lens Model* (Juslin 1995, 2000). This model can help us understand many crucial issues concerning expression of emotion in music. One important goal in this domain is to better understand how composed and performed cues *interact* in expression of emotion (Juslin 1998, p. 50). The problem, of course, is the enormous complexity: there are so many musical features and their potential interactions to consider (see Table 5.1). Hevner's (1935, 1936) pioneering work was important, though she lacked a number of modern research tools, such as computer synthesis and certain multivariate techniques, that may be needed to make real progress. How can we approach the complex interplay between musical features in a practically feasible way?

We have recently proposed an *Expanded Lens Model* (Juslin and Lindström 2003; Fig. 5.2). The Lens Model was originally applied only to performance features (Juslin 2000). However, in the expanded version, both composer cues and performance cues are included to make it possible to explore their relative contributions. In addition, important interactions between performer and composition cues are included as predictors in the model. The goal is also to be able to model the emotion judgements of individual listeners. As in our previous research (Juslin 1997*b*, 2000), we are using a statistical approach based on multiple regression analysis. Contrary to popular belief, it is actually possible to investigate the relative contributions of interactions between predictors within the framework of multiple regression analysis. Recent studies

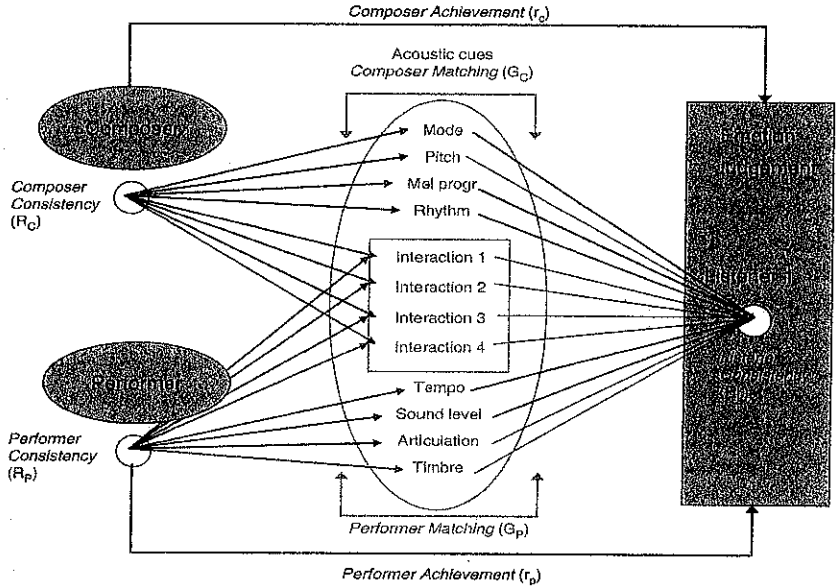

Fig. 5.2 Extended Lens Model (ELM) of musical communication of emotions. (Adapted from Juslin and Lindström 2003)

based on this framework, using both analysis and synthesis (e.g. Juslin and Lindström 2003), indicated that a large amount of the variance in listeners' emotion ratings could be explained by a linear combination of the main effects alone (typically around 75–85 per cent). Furthermore, results indicated that interactions between composed and performed features made small (but not negligible) contributions to the predictive power. Thus, an important lesson from this investigation was that, although there *are* interactions among musical features, we should not overstate their importance; they may be fewer and smaller than previously believed. (Further evidence that jugdements of affective qualities of music reflect mainly an additive combination of musical features were reported by Makris and Mullet 2003.)

Much work remains to be done in order to fully understand musical expression, but it can be concluded that people can express and perceive different emotions in music (cf. Fig. 5.1).

Induction of emotion

Does music induce emotions in listeners? It might appear obvious from everyday experience that music induces emotions in listeners. Anecdotal evidence

on the emotional powers of music is certainly abundant; yet we know better than to accept such reports at face value. Is there scientific evidence supporting the idea that music can induce emotions? Emotions are inferred on the basis of three kinds of evidence: (a) *self-report*, (b) *expressive behaviour*, and (c) *physiological reaction*. Empirical evidence of emotional reactions to music comes from several strands of research which are summarized in Table 5.2.

Table 5.2 Examples of evidence of emotional reactions to music from various strands of research.

Type of research	Finding
Experiments	Music produces differentiated effects on self-report, physiology, and behaviour (Davis and Thaut 1989; Kallinen 2004; Krumhansl 1997; Nyklíček *et al.* 1997; Panksepp, 1995; Pigniatello *et al.* 1989; Pike 1972; Vaitl et *al.* 1993; Waterman, 1996; Västfjäll, 2002).
Qualitative interviews	Listeners employ music to regulate, enhance, and change qualities and levels of emotion. They show considerable awareness about the music they need to hear in different situations to induce particular emotions (DeNora 2001; Gomart and Hennion 1999).
Brain imaging and EEG	Listeners' responses to music involve subcortical and cortical regions of the brain that are known from previous research to be involved in emotional reactions (Altenmüller *et al.* 2002; Blood and Zatorre 2001; Peretz 2001; Schmidt and Trainor 2001).
Field studies	Music influences consumer behaviour, helping, and interpersonal attraction and conflict (Fried and Berkowitz 1979; Honeycutt and Eidenmüller 2001; May and Hamilton 1980; North and Hargreaves 1997a; North *et al.* 2004).
Questionnaires	Music serves various emotional functions in everyday life: to change moods; to release emotions; as a source of comfort; to match current mood; as a source of enjoyment; to relieve stress, etc. (Behne 1997; Juslin and Laukka 2004; Panzarella 1980; Roe 1985; Sloboda 1991; Sloboda and O'Neill 2001; Zillman and Gan 1997; Wells 1990).
Music therapy	Music facilitates the expression, identification, and experience of emotions; improves the control of one's own emotional behaviour; helps to 'trigger' emotionally-laden memories of past events; and helps to diagnose patients' psychiatric conditions (Thaut 1990).
Ethnographic research	Emotional response to music is a 'universal' phenomenon, typically involving feelings of happiness and arousal, although the particular forms of engaging with music may differ from one culture to another (Becker 2001; Blacking 1973).

While each source of evidence is uncertain, the *combined* evidence is quite compelling. It should be noted, however, that few studies so far have investigated induction of emotion as part of a musical communication process (Fig. 5.1).

Which emotions does music typically evoke? If we accept the fact that music can induce real emotions in listeners, one might then ask whether the emotions induced by music include the full range of human emotions. In principle, depending on the particular situation, the person listening, and the music, it would indeed seem possible that music could arouse just about *any* emotion that can be felt in other realms of human life. A more interesting question, perhaps, is which emotions music *usually* induces in listeners. As we will see, the set of emotions typically *induced* by music may be a somewhat different set of emotions than that typically *expressed* by music – for natural reasons. The emotions that are most easy to express and perceive in music are the basic emotions (e.g. happiness, sadness, anger, fear, love/tenderness) that have distinct expressive characteristics in *other* non-verbal communication channels; notably, the non-verbal aspects of speech and human body movement (see Atkinson *et al.* 2004; Juslin and Laukka 2003). Emotions *induced* by music, on the other hand, are more determined by the nature of the appraisal of the musical event and the specific reasons for engaging with the music in a particular situation. Perhaps the most frequently cited reason for listening to music is *enjoyment*. Thus, we would expect joy to be one of the most frequently felt emotions in relation to music, which – as we shall see – may indeed be the case.

There is little research on the 'epidemiological' aspects of musical emotions (i.e. how often people experience different emotions to music under different circumstances). However, there is some preliminary evidence from questionnaire studies. Table 5.3 shows the emotions reported to be felt most frequently in response to music in a recent study of 141 music listeners (aged 17–74) by Juslin and Laukka (2004). These findings are interesting for several reasons. First, it is quite clear that positive emotions (e.g. happy, relaxed, moved) dominate among the most commonly evoked emotions. This is what we should expect. After all, people can usually (although far from always) exercise choice over what music to listen to. Given this choice, people will tend to prefer to listen to music that they like and that makes them 'feel good'. Hence, it should come as no surprise that positive emotions are most common in musical experiences (see also Becker 2001; Gabrielsson 2001; Sloboda and O'Neill 2001), whereas this may *not* be the case in 'everyday life' (e.g. Oatley and Duncan 1994). Secondly, the results in Table 5.3 clearly indicate that music *does* induce 'basic emotions' in listeners (contrary to some claims in the literature; Scherer 2003), although perhaps more often happiness and sadness than anger and fear (fortunately!).

Table 5.3 Preliminary evidence on the relative frequency of felt emotions in response to music, as estimated by listeners (based on Juslin and Laukka 2004). Note: Emotions are listed from the most commonly experienced to the least commonly experienced (N = 141).

1. Happy*	23. Empathic
2. Relaxed*	24. Proud
3. Calm*	25. Spiritual
4. Moved	26. Curious
5. Nostalgic	27. Relieved
6. Pleasurable*	28. Bored
7. Loving*	29. Indifferent
8. Sad*	30. Frustrated*
9. Longing*	31. Tense*
10. Tender	32. Disappointed*
11. Amused	33. Surprised*
12. Hopeful	34. Honoured*
13. Enchanted	35. Regretful
14. Expectant*	36. Contemptuous
15. Solemn*	37. Confused*
16. Interested	38. Anxious*
17. Admiring	39. Afraid*
18. Angry*	40. Jealous
19. Ecstatic*	41. Disgusted
20. Lonely	42. Guilty
21. Content*	43. Shameful*
22. Desiring	44. Humiliated

* These emotions were mentioned in free descriptions of strong experiences of music (SEM), as reported by Gabrielsson (2001, Table 19.2).

Evidence on what emotions music induces also comes from Gabrielsson's studies of strong experiences of music (SEM), which involved hundreds of extensive, retrospective verbal reports from listeners on their most profound musical experiences. Gabrielsson (2001) notes that 'in the reports, we find numerous examples of so-called "basic" emotions' (p. 446). He also notes, with respect to the question of whether there are emotions that music does *not* induce, that 'too hasty exclusions should be avoided' (p. 446). However, his results also suggest that positive emotions dominate in SEM. Those emotions

in Table 5.3 that were mentioned in Gabrielsson's SEM reports are indicated with asterisks (based on Gabrielsson 2001, Table 19.2). Thus, it appears that some emotions are more commonly induced by music than others. Perhaps researchers should actually accommodate to this fact in regard to how they measure emotion? Indeed, some researchers have argued that we should develop specific rating scales for induced musical emotions. For examples of such scales, see Asmus (1985), Bartel (1992), and Juslin and Laukka (2004).

How, exactly, do musical events induce emotions in listeners? This problem is still puzzling to researchers. One problem appears to be that the conditions of emotion-elicitation in music are different from those in real life. In the paradigmatic case, an emotion is aroused when an event is appraised as having the capacity to influence the goals of the perceiver somehow (Oatley 1992). Because music has no direct capacity to further or block goals, a challenge for music researchers is to provide an alternative, but plausible, account of how music can arouse emotions (Sloboda and Juslin 2001). A number of different theoretical mechanisms have been proposed to explain how music may arouse emotions, including (but not limited to) the following ones:

- *Musical Expectancy.* Meyer's (1956) groundbreaking book on how musical expectations are created, maintained, confirmed, or disrupted offers one fruitful solution to the problem of the 'formal object' of musical emotions ('What is musical emotion about?'): Emotions to music are induced when our schematic expectations are interrupted. Research by Kraehenbuehl and Coons (1959) suggests that many listeners prefer places in musical patterns where their expectations are confirmed rather than places where they are interrupted. This can help to explain the wide-spread rejection of so-called 'contemporary music', which has a tendency to disrupt rather than confirm almost any melodic expectancy of the average listener. Meyer (1956) himself acknowledged that mere arousal through interruption of expectancies has little value. To have any aesthetic meaning, the arousal or tension must be followed by a satisfying *resolution* of the tension. While influential and respected, Meyer's theory has not actually stimulated much research, presumably because of the problems in testing the theory. A specific piece of music may produce many different musical expectations at different levels of the music (and these expectations may be different for different listeners), wherefore it is hard to understand or predict exactly what the listener is reacting to. For recent models of expectancy, see Eerola (2003), Hellmuth Margulis (2003), and Rozin (2000).
- *Mood Contagion.* There is evidence that people may easily 'catch' the emotions of others when seeing their facial expressions or hearing their vocal expressions, perhaps through primitive 'motor mimicry' (e.g. Hatfield *et al.* 1994; Neumann and Strack 2000). Because music often features expressive acoustical patterns that are similar to those in emotional speech, it has been hypothesized that we get aroused by the voice-like aspects of music through a process in which a neural module reacts quickly and automatically to certain stimulus features, which leads us to 'mimic' the perceived emotion internally (Juslin and Laukka 2003, pp. 802–3).

- *Arousal Potential.* We do not only react to the emotion-specific patterns of acoustic cues in pieces of music (as noted earlier), we also react to the inherent 'arousal potential' of more general stimulus characteristics, such as its complexity, ambiguity, and familiarity. Part of our emotional responses could reflect our attempt to 'make sense' of the information in the music. According to Berlyne's (1971) influential theory listeners will tend to prefer music that gives them an optimum level of arousal: If the arousal potential of the music is too high, listeners will reject the music; if the arousal potential is too low, listeners will also reject the music. Hence, Berlyne hypothesized that listeners' preferences are related to arousal (or some aspect of it, e.g. perceived complexity) in the form of an inverted U-shaped curve. Berlyne's theory has received empirical support (e.g. North and Hargreaves 1997*c*), and has been especially influential in accounts of music *liking* and *preference*. It is less clear how his theory could account for the induction of discrete emotions by music (but for some interesting ideas, see North and Hargreaves 1997*b*). One particular feature of the musical stimulus that can explain many emotional responses is its perceived *beauty* (see, e.g. Gabrielsson 2001, p. 447). Unfortunately, there is no thorough theory of musical beauty that can guide work in this area.
- *Associations.* Emotions to music often reflect personal and idiosyncratic associations based on arbitrary and contingent relationships between the music experienced and various non-musical factors related to emotion (what Davies 1978, refers to as the 'Darling, they're playing our tune' phenomenon). Associative responses to music involve 'primitive' learning mechanisms (such as conditioning) that are not available to conscious introspection, but the responses typically evoke emotionally laden memories of specific places, events, or individuals (Gabrielsson 2001). In fact, research indicates that listeners often use music as 'a reminder of valued past events' (Sloboda and O'Neill 2001), and that specific pieces of music may be strongly associated with particular time periods of an individual's life (e.g. Schulkind *et al.* 1999). Hence, nostalgia may be one of the more commonly felt emotions in regard to music (Juslin and Laukka 2004).
- *Mental Imagery.* Music can be highly effective in stimulating mental imagery. The images may not necessarily be about the music (or the musicians), but

could be about anything. Still, the music may be important in *shaping* the images. Guided imagery in music (GIM) is an established method in music therapy (Bonny and Savary 1973), where 'the traveller' is invited to 'share' his or her images as they are experienced in real time during a programmed music sequence. Emotions experienced are presumably the result of an interaction between the structure of the music and the structure of the images. Also in non-clinical settings, mental imagery may be an effective means to enhance emotional responses to music, both for listeners (Band *et al.* 2001–02) and musicians (Persson 2001).

Unfortunately most theories of musically induced emotion have not actually been thoroughly tested yet. However, one thing appears certain: there is no *single* theoretical mechanism that can account for *all* instances of musically induced emotion. Hence, Juslin (2004) recently proposed a multi-component model of musical emotions, featuring a hierarchy of psychological mechanisms at different levels of processing – each with its own evolutionary history and characteristics. This model leads to a number of predictions that could guide future research. A novel research project, *Appraisal in Music and Emotion* (*AMUSE*), is currently testing the model using a combination of field and laboratory studies.

In sum, evidence indicates that music does not only express emotions that are recognized by listeners, it does also occasionally induce emotions in listeners (cf. Fig. 5.1).

Discussion

Objections to music-as-communication

It can be concluded from the previous review that there really is a sense in which music can be regarded as a means of musical communication. Performers and listeners actually *do* think of music as communication of emotion (perhaps particularly in popular music), and composers and performers actually *can* communicate discrete emotions to listeners, although there are definitive limitations on what music can communicate reliably. Thus, the communicative aspect of music is something that cannot be denied. Even so, the transmission model of music has been described as 'old-fashioned' (Serafine 1980) and 'naive' (Swanwick 1985), as a 'Romantic notion' of music (Budd 1989). Why has the transmission model of music so often been dismissed? Goehr (1992) notes that:

> 'As soon as we talk about music as communication, we imply a topography and arising from it a politics ... The politics is played out between the sometimes complementary and sometimes conflicting concerns of [composers, performers, and listeners] ... Should the entire process be regarded as the recreation of the composer's original intention? ... Or then again is music really a performing art? ... Or again, should not everything be evaluated from the point of view of the recipient? After all it is he who pays!' (p. 125)

Indeed, the question of music's value seems to be a key issue (cf. Budd 1989). Music may communicate emotions. However, from this we must not conclude that the value of music resides only, or even primarily, in its emotional-communicative functions. Music is not merely a tool for communication of emotion, since 'Art can exist without the need to communicate anything at all' (Goehr 1992, p. 131). This is a fascinating aspect of some human communications: the symbols *themselves* rather than their interpretation may come to be the important part of the message (e.g. Johnson-Laird 1992). It is reasonable to assume that music developed from a means of emotion sharing and communication to 'an art form in its own right' (Juslin and Laukka 2003). Objections to music-as-communication often centre around the problem of how to do music justice as an art form, which is a legitimate concern. But the solution is not to deny music-as-communication, but rather to investigate the topic better (see the following section).

Another objection to music-as-communication involves its possible consequences for music teaching. Serafine (1980) argues that the transmission model of music has had a negative impact on music education by leading to an over-emphasis on passive-receptive skills (partly reflecting a research focus on perceptual processes) at the expense of more active skills, such as composition. Although it could be true that music education has over-emphasized skills related to perception, it should be noted that the transmission model actually implies an *equal* focus on 'active' processes (composition, performance) and 'passive' processes (listening) (see, e.g. Fig. 5.2). Thus, it may be premature to blame the transmission model for the current state of affairs in music education, which more likely reflects the fact that it is easier to study perception than it is to study skills like composition and performance (Sloboda 1994). In my estimation, the transmission model could have a positive influence on music education. Goehr (1992) observes that 'most performers and listeners still do consider music in terms of its affects', but that 'academic attention is principally focused upon problems of structure' (p. 128). The transmission model could help to counter this imbalance by focusing more on the *meaning* communicated by music – its contents. Such a focus would be more compatible with how musicians conceive of music (Persson 2001). Musicians as well as listeners relate to music in highly *personal* ways, and there is a strong *social* dimension in how we respond to music. It seems only reasonable that music education should accommodate to this fact in order to better

reflect the essence of human music making. It is thus reassuring to note that the transmission model has recently contributed to computer applications in music education that focus on emotion and expression (Juslin *et al.* 2004).

Agenda for future research

If we accept the basic validity and utility of the transmission model, there are still a number of limitations of earlier research based on this model that offer incentives for further research. For example, a definitive conclusion that can be drawn on the basis of the present review is that most previous research on expression, perception, and induction of emotions has neglected *the social context* of musical emotion, including everything from the situation in which the musical activity takes place to the wider socio-cultural context (North and Hargreaves 1997*c*). This neglect may be particularly unfortunate for research on *induction* of emotions by music, because it has obscured several issues that could prove to be critical to an understanding of music and emotion, including, for instance, listeners' motivations for listening to music; epidemiological aspects of music and emotion; individual differences; and listeners' uses of music in various everyday contexts (Juslin and Laukka 2004). Neglecting the context of music listening might lead to a view that emphasizes sublime, aesthetic emotions to 'works of art'. While such a view may be popular with musicians, no doubt, it has limited validity in terms of fully accounting for how most *listeners* actually relate to music. The consequence might be theories of musical emotion that overly emphasize musical structures and sources of emotion related to structure (expectancy, iconic sources) at the expense of the rich personal associations listeners have to music, and that may involve a wider variety of human emotions. Thus, I argue that a move to extend research on music and emotion to everyday life contexts represents one of the most promising avenues towards a better understanding of how humans experience emotions in connection with music. This could involve diary studies (Bolger *et al.* 2003; e.g. Sloboda and O'Neill 2001), field observations (Miller and Strongman 2002), questionnaire studies (Juslin and Laukka 2004), qualitative interviews (DeNora 2001), and cleverly designed experiments (Szpunar *et al.* 2004).

One aspect of the context left out in previous studies is *the relationship between music and lyrics*. The work reviewed here concerns mainly instrumental music, and the conclusions about the limitations on what music can communicate reliably from the composer or the performer to the listener applies only to instrumental music. However, the great majority of everyday listening to music in different cultures arguably involves music linked with words (Clarke 1952), and the combination of words and music offers a very precise means of communication of emotions, in which the two 'channels' – verbal and non-verbal – complement each other (e.g. the suggestive 'mood' of the music renders emotional 'depth' to the precise cognitive contents of the lyrics). A number of studies have investigated the emotional characteristics and effects of lyrics (Anderson *et al.* 2003; Hansen and Hansen 1991; Whissell 1996) but there is little research on the *interaction* between lyrics and music (see Stratton and Zalanowski 1994, for one example). Further study of the combined effects of music and lyrics is thus urgently needed.

What are the implications of these future directions for the transmission model? First of all, it must be noted that very few studies so far have actually modelled the *complete* communicative process (Fig. 5.1). The expanded lens model (see Fig. 5.2) includes most aspects but still leaves out induction of emotion. However, a rare study by Lundqvist *et al.* (2000) investigated how a musician's composition and performance of two pieces of music intended to communicate happiness and sadness, respectively, affected listeners' perception and induction of emotions through the use of self-reports and continuous measures of physiological reactions and facial expressions. The results suggested that music intended to express happiness was perceived as happy and induced happiness, and that music intended to express sadness was perceived as sad and induced sadness. This study may serve as a model for future research, though even this study left out several aspects of the context, as well as lyrics. Clearly, the transmission model needs to be augmented by adding variables related to the social context to the analysis. In my view, there is nothing in the transmission model that precludes a consideration of social aspects. If anything, the transmission model serves to underscore that music making is at heart a social process. Thus, for instance, the expanded lens model could be used to model individual differences in emotional communication (e.g. due to different cultural backgrounds), also including predictors of specific social situations in the statistical analysis.

Ultimately, the value of the transmission model depends on the goals of the research: do we want to investigate musical *communication* of emotion (as defined on pp. 86–9) or emotional responses to music in general? All studies of communication must rely on *some* communication model (which cannot be altogether different from the transmission model). However, emotional responses to music are not always about communication, but could involve other processes and phenomena for which the transmission model does not really apply. In addition, the transmission model does not suffice to *explain* induction of emotions. What is needed is to develop a detailed model of the *cognitive appraisal process* that underlies emotional reactions to music (e.g. Juslin 2004). Given the extremely large number of different potential sources of musical emotion, such an endeavour is a formidable undertaking.

A cognitive appraisal model could, of course, be a part of a transmission model, but it could also stand alone. The point is that, as long as we realize that the transmission model is only part of the story, applicable to only some music phenomena (cases of *genuine* communication), the model is a highly valuable tool to describe how humans express, perceive, and induce emotions in music. Hence, continued use of the transmission model is likely to increase, rather than decrease, our appreciation and admiration for music as a human art form.

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