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Facing a New Era in Studying Music-Induced Emotions – How Letting Go of the Status Quo May Help Seeing the Seemingly Invisible

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ABSTRACT

A closer look on research about music and emotion reveals that the distinct but related phenomena 'emotion' and 'feeling' are often used interchangeably. In order to obtain valid results, one should be aware of the phenomenological differences of these two affective states. In addition, there is an urgent need to find separate methodologies for studying the two distinct phenomena of perceived emotion in music and music-induced emotion in order to obtain valid data, and to draw valid conclusions regarding individual hypotheses and research question. This paper evaluates the limitations attached to the state-of-the-art methods and introduces a novel method that may be able to fill the gaps that traditional methods like self-report and physiological measurements are not able to fill at the moment. Using facial expressions of emotion for studying music-induced emotion may lead to new insights on experienced emotion and enable the possibility of studying musical emotions cross-culturally without the limitations language provides.

I. BACKGROUND

One challenge when studying emotions in music is the need for further specification in emotions *perceived in* music, and emotions *induced* or *evoked by* music. Emotions perceived in music can briefly be described as emotional features that can be *recognized* in music, based on cultural background, frequent exposure to music, as well as features music shares with other means of communicating emotions (e.g. prosody in language) (see e.g. Davies, 2010). Emotions induced by music, on the other hand, are experiences or sensations that are subjectively *felt* in response to music (Koelsch, 2012; Koelsch, Siebel, & Fritz, 2010). These two phenomena can occasionally, but do not necessarily need to, overlap, meaning that music that is perceived as sad, does not have to evoke a feeling of sadness (or any feeling) in the listener (Robinson & Hatten, 2012).

Although emotions perceived in music and music-induced emotions are rather different, methods used for investigating these two phenomena tend to overlap which challenges the *reliability* of some of the obtained results. Kelley (1927) suggests that reliability can simply be reached by measuring the data one was aiming to measure (p.14). In the case of measuring musical emotion, this suggestion may not always be followed as strictly as it should be. The reason might be that often the distinction between emotion and feeling is not taken into consideration. In addition, applying the same or very similar research methods for studying both, music-induced emotion and perceived emotion in music, can be speculated to contribute to non-reliable data and conclusions.

II. STUDYING EMOTIONS

A. Emotion vs. Feeling

Not only can the awareness of the distinction between the two different kinds of musical emotion be a challenge, also the differentiation between the two related but dissimilar concepts of *emotion* and *feeling* is not always made clearly. Often these two terms are used interchangeably which does not help when trying to understand their underlying mechanisms and meaning.

One of the reasons that there is no consequent categorization is that researchers are struggling to find consensus about the actual characteristics that can be ascribed to emotion, and how emotions can be differentiated from other affective states such as mood and feeling (Zentner & Eerola, 2010). I evaluated the definitions offered by Keltner and Gross (1999), Niedenthal, Krauth-Gruber, and Ric (2006), Johnson-Laird and Oatley (1989) and Sloboda and Juslin (2010) (see Kayser (2016) for a more detailed overview) and found that they boil down to the conclusion that emotions are brief and episodic phenomena in response to events that are perceived in either the internal or external environment. Furthermore, they can be characterized as spontaneous, involuntary, and automatic, and lead to measurable changes in physiology, such as heart rate and perspiration. There are at least three characteristics that are embodied when an emotion is experienced: behaviors (e.g., gait, posture, facial expressions), changes in physiology (heart-rate, perspiration), and subjective feelings (Sloboda & Juslin, 2010; Yiend & Mackintosh, 2005). Emotions are activated by changes in arousal on a level beyond consciousness and it depends on one's attentional focus if, and to what extent, emotions are consciously experienced, and how they are interpreted in terms of their valence (positive – negative). In their study on emotional memory, Kensinger and Corkin (2004) found that two distinct neural and cognitive processes are involved in information about arousal (amygdalar-hippocampal network) and information about valence (prefrontal cortex-hippocampal network). Damasio (1995) states that even covert emotional experiences not available to consciousness can still influence the reasoning and decision-making mode (p.185). This has for example been shown in studies on the subliminal influence of music on customer behavior (North & Hargreaves, 1996; North, Hargreaves, & McKendrick, 1999; Spangenberg, Grohmann, & Sprott, 2005; Turley & Milliman, 2000). Emotional experience thus does not need to involve cognition (in the sense that it does not require attentional focus and awareness), but can lead to changes in cognition. Simultaneously changes in cognition and certain thoughts can lead to emotional responses, which may be the case in "over-thinking", causing emotions related to fear (e.g. anxiety). It can be speculated that two separate neural routes are involved

in these processes, but as far as I am aware there is not enough empirical evidence yet to support this idea.

Feelings can be understood as the cognitive representation and/or interpretation of an emotion. Damasio (1995) argues that even though some feelings are related to emotions, not all feelings result from emotions and not all emotions result in feelings (p.143). Feelings that do not relate to emotions are called *background feelings*. Rather than being based on an emotion, Damasio regards these feelings as body states prevailing *between* emotions (p.150). *Feelings of (basic universal) emotions* on the other hand result from the dynamic and uninterrupted change of body signals that are monitored by different parts of the brain and can be measured based on (electrical) neural and neurochemical (hormonal) signals. Damasio further argues that "a feeling depends on the juxtaposition of an image of the body proper to an image of something else", for example a visual image or an auditory image (p.145). Changes in cognitive processes are simultaneously induced by neurochemical substances (e.g., neurotransmitters released during the initial emotional response) and contribute to the completion of a feeling. He concludes that "[a] feeling about a particular object is based on the subjectivity of the perception of the object, the perception of the body state it engenders, and the perception of modified style and efficiency of the thought process as all of the above happens" (Damasio, 1995:147).

Emotion and feeling are two complex concepts that can, but not always have to be, interdependent. Being able to grasp the difference between the two phenomena is crucial for the choice of research methods.

B. Emotion Models

Theories about emotions have been developed already in the Antiques by Aristotle (Dow, 2011) and this puzzling phenomenon has been of interest to philosophers, psychologists, and neuroscientists over the last millennia. In the last few decades the two most influential emotion theories have been developed: the *Dimensional Model of Affective States* and the *Discrete Emotions Theory*. As these models also influence research on emotions in music, I am introducing these two models very briefly in this section.

The most influential model has been developed by Russell (1980) in an attempt to represent emotion inside a circular two-dimensional space. The so-called *circumplex model* classifies emotion by *valence* (pleasure – displeasure) on the horizontal axis and *arousal* (activation-deactivation) on the vertical axis. In this model, eight affect concepts (arousal, excitement, pleasure, contentment, sleepiness, depression, misery, distress) are placed in the circular model in such a way that opposite concepts form a bipolar dimension (e.g., arousal-sleepiness). Russel furthermore conducted several studies to validate his model, for example by letting subjects place emotion words inside the model based on perceived valence and arousal.

The *Discrete Emotions Theory* (also: Categorical Emotion Theory) suggests that emotions are experienced as distinct categories (Sloboda & Juslin, 2010). Yiend and Mackintosh (2005) argue that basic emotions form the basis for the immense variety of emotion that can be experienced. There are different theories among scholars on how many and which emotions are to be included in the set of basic emotions. Ekman (1992) defines nine characteristics that need to be fulfilled to classify an emotion as basic emotion. One of these characteristics states that an emotion needs to be accompanied by a distinct facial expression. Facial expressions of emotion are regarded as readouts of inner states (Buck, 1994) which occur involuntarily and spontaneously with little to none volitional control (Ekman, 1991). So far, five basic emotions have been identified: *anger, fear, sadness, disgust,* and *enjoyment* (Ekman, 1992:170). Ekman further suggests that all other emotional states can be derived from these categories (see also Sloboda & Juslin, 2010). Further emotion categories may be added to the list if further studies show empirical evidence that the required characteristics are present.

III. AIM

The first aim of this paper is to open a discussion about current methods that are used for studying emotions in music while focusing on the more complex phenomenon of emotions that are experienced or felt in response to music. Another goal is to raise concerns over the reliability of the data collected with the methods predominantly applied in research on emotions in music, and suggest how research strategies may be improved so researchers can work towards a better understanding of emotional experiences with music. Along these lines I will introduce the possibility of including the automatic analysis of facial expressions of emotions in connection with studies on music-induced emotion with an attempt to bridge some gaps that are accompanying more traditional approaches.

IV. STUDYING EMOTIONS IN MUSIC

When studying emotions in music, one first has to determine if one wants to focus on perceived emotions in music or music-induced emotion (or possibly both). The challenge here is not only the distinction of the two phenomena qua definition, but also to understand the different mechanisms that are involved in these experiences. In his book *Embodied Music Cognition and Mediation Technology* (2007) Marc Leman suggests three different approaches to describe a musical experience. In the following section I give a brief summary of the *first-*, *second-*, and *third person description of musical experience*, which will be the basis for the discussion of methodologies that can be used for studying the different kinds of musical emotion in the remainder of this paper.

A. First, Second, and Third Person Description of Musical Experience

Leman (2007) defines the *first person description of musical experience* as a language-based description of the world, which results from a subjective interpretation. First person descriptions cannot be observed from the outside and solely be obtained through introspection. Leman refers to this phenomenon as *cerebral intentionality* (p.79). The *second person description of musical experience* is formed by the expression and articulation of a subjective experience from one person to another. Leman proposes that corporeal articulations may serve as a form of second person description of musical experience. He stresses that the most important difference between the first person and the second person description is that the first person description is characterized by a (cerebral) interpretation of an intended act whereas the second person description reflects the (corporeal) articulation

of an intended act (p.77). Articulations defined as second person description are considered being more spontaneous and body based. The *third person description of musical experience* is based on *repeatable measurements* (p.79), for example of phenomena that cannot be observed from the outside, but are known to indicate an underlying emotional experience, for example heart-rate variability, pulse, perspiration, etc.

B. Methods for Studying Emotions in Music

1) *Self-report.* Self-report is a form of first person description. When studying emotions in music, self-report is the most popular method used. Self-report can be obtained in many different ways. The most common strategies used are forced choice categories where listeners have to choose from a researcher-selected set of categories, e.g. from the Differential Emotions Scale (Izard, Libero, Putnam, & Haynes, 1993), and free descriptions methods, where listeners describe the experience in their own words. Information is gathered either *offline* (static, after a stimulus has been presented) or *online* (continuously, during stimulus presentation). Judgments are made either by using rating scales (e.g. ratings of arousal, intensity, or valence) that are inspired by the dimensional model of affective states, or by selecting one or more emotion words. These emotion words are not necessarily taken from the basic emotion categories, as it has been suggested that music evokes a much wider and manifold emotional spectrum. Based on that idea, Zentner, Grandjean, and Scherer (2008) introduced the Geneva Emotional Music Scale (GEMS) to study music-induced emotions. Additional to the basic emotions "sadness" and "joy" the scale includes the following emotions that are associated with music: tender longing, amazement, tranquility, activation, power, sensuality, transcendence, and dysphoria.

In a study on emotion models, Vuoskoski and Eerola (2011) compared the dimensional model, discrete emotion model, and the GEMS and that the application of the discrete emotion model appears to be the least efficient as some participants had difficulties applying the provided scales to their own responses. Even though the nine categories of the GEMS may be more nuanced and more related to musical emotions, the dimensional model appeared to be the most reliable approach for collecting data on experienced emotions.

2) *Physiological Measurements*. Emotions can be inferred from physiological changes in heart-rate, perspiration, etc.. This approach can be classified as a form of third person description and has frequently been used in studying emotions in music. These physiological measurements only give information about the change in arousal, and should be interpreted with great care as they can also occur under several other circumstances, like fever in illness (Yiend & Mackintosh, 2005:494). Because of this ambiguity they are often combined with some form of self-report.

3) *Behavioral Measurements.* Behavioral measurements (or observations) are a form of second person description of musical experience. One distinct behavior related to emotion is the display of facial expressions of emotion. Facial expressions of emotion are spontaneous and involuntary manifestations of an emotional experience that are displayed with little to none volitional control. Ekman and Friesen Ekman and Friesen (1978) identified more than 40 facial muscles that are involved in displaying emotion and other means of communication and extracted distinct patterns of muscle activity that are forming the basic emotions. Based their findings the developed the Facial Action Coding system which is a catalogue for coding facial behavior. Not many studies on emotions in music have looked at facial expressions of emotion. The main focus has been on two muscles: zygomaticus major (involved in smiling) and corrugator (involved in frowning). The zygomaticus is an indicator for positive valence whereas the corrugator is seen in relation to negative valenced experience (Hunter & Schellenberg, 2010). Facial muscle activity can be measured by using Electromyography (EMG). In EMG electrodes are placed above the skin above the center of the muscle of interest. Using facial EMG, Livingstone, Thompson, and Russo (2009) measured zygomatic and corrugator activity in the context of emotional singing, and found increased zygomatic-activity when "happy"-rated songs were imitated and increased corrugator activity during the imitation of "sad"-rated songs. Witvliet and Vrana (2007) found greater zygomaticus activity for music that was positively valenced and high in arousal and activation of the corrugator muscle for negatively valenced music, independent of level of arousal. Weth, Raab, and Carbon (2015) have applied automated face analysis in combination with self-report for studying self-selected sad music (SSSM) and reported that a trend of happy facial expressions could be detected when happiness was reported in response to SSSM which was not the case in unfamiliar sad music.

IV. CRITICAL EVALUATION OF METHODS WITH A FOCUS ON STUDYING MUSIC-INDUCED EMOTION

In the first part of this paper I have pointed out that the difference between emotion and feeling is crucial when one wants to study emotions in music, as both phenomena require different approaches.

Any form of *self-report* can only grasp something one is either aware of experiencing or perceiving. This method is most sufficient when studying either perceived emotion in music as this requires a judgment and interpretation of musical features, based on cultural understanding, previous exposure to music, background in music theory and composition practices, etc.. It seems to be easier to investigate perceived emotions in music rather than music-induced emotions. At least in Western society, a shared cultural knowledge exists about how e.g. 'sad' or 'happy' music *should* sound like. This is one reason why the mood induction procedure, used in movies to create a certain atmosphere with music and sounds, is used so frequently. Because of this shared knowledge and frequent exposure, listeners tend to agree more often on perceived emotional characteristics than it is the case with music-induced emotions as these are more dependent on individual factors. For studying emotions evoked by music self-report may not be not the ideal method to use. As emotions are a subconscious phenomenon and not always consciously experienced as feelings, it is difficult to access them. Another issue are demand characteristics (Zentner & Eerola, 2010): as emotion categories in the forced choice format are fixed, it cannot be sure whether a listener experiences any of the emotions that can be selected, or selects one of the options because he or she assumes that a

certain emotion word represents the emotional feeling he is *supposed* to feel. In addition, the emotion reported could be an emotional feeling that is experienced independently from the music, or a background feeling.

Another issue here is that the amount of emotion categories as well as the categories themselves that can be selected by a listener are biased by the preferences of the researcher (*researcher bias*). This leads to different emotion categories in different studies, which makes comparison and generalization of results difficult.

When a free-description method is applied, listeners are able to choose their own emotion labels. This enables listeners to freely express their experiences in very short to very long descriptions. Problematic here is that the collected terms have to be clustered subsequently so that data analysis is possible. Listeners sometimes have difficulties expressing their emotional experiences with words. In addition, not every culture uses the same emotion categories. They may be more fine- or coarse grained than in the Western culture. In addition, emotion words used in the English language do not always translate to other languages, which makes a cross-cultural application and an attempt to generalize result impossible. This does not mean that the experience of emotion is not universal, but that language used to describe them is ambiguous and shaped by the preferences of cultures and individuals.

Some of the difficulties mentioned above can be avoided when emotions are reported on the basis of two or more dimensions, like valence and arousal, as described in the circumplex model. As with the other forms of self-report described, an uncertainty about what is reported (music-induced emotional feeling, perceived emotion in music, or background feeling) remains. In addition, self-report is often collected after stimulus representation (*offline*) and thus does not take into account that several and different emotions can be evoked during a listening experience. No information about the time-development of an emotion episode is available.

Measurements of physiological changes only give information about the change of arousal over time. Peak moments in the data stream indicate emotional experiences. As the measurements are made continuously (*online*) during a listening experience we can assess the development of one or several emotional experiences over time. This information is especially important if one wants to investigate music-induced emotion as the data can be compared with different features (e.g., waveform, lyrics) of the musical stimulus. This can lead to a better understanding about the musical features that are correlating with the time point at which a peak experience is detected. A disadvantage with this method is that we one can only infer *whether* an emotion is experienced, but to obtain information about the emotion-type, physiological measurements are usually combined with self-report.

Behaviour measurements have not been used much in the study of emotions in music, probably because it is challenging to find ways for data quantification.

Since the development of the Facial Action Coding System, facial expressions of emotion have been used frequently for studying emotions. When studying emotions in music, on the other hand, facial expressions of emotion have only gotten very little attention. As at least for a distinct set of emotions facial expressions of emotion are suggested to be universal across cultures, one cannot only infer *whether* an emotion is experienced but also *which* emotion. Facial expressions of emotion can be coded manually but this process is very time-consuming, as has been discussed elsewhere (see Kayser, 2016, 2017). Facial EMG has been successfully used in some experiments to determine the valence of an emotion (Livingstone et al., 2009; Witvliet & Vrana, 2007), but as electrodes have to be placed on facial muscles, the listener's attention is put on the area of interest. This might reveal the research question and decrease the reliability of the measurement. Using automated face analysis seems to be an ideal strategy: the only equipment needed is a video camera, which can be concealed. Faces of listeners can be recorded and then analyzed by using software, like *FaceReader* by Noldus Information Technologies (2015), which has been. *FaceReader* uses 500 key points to create a face model. The key points serve as a template in which the recorded face is implemented. The software then automatically detects changes in muscle movement, assigns action units to the areas of the face where activation is detected, and identifies six facial expressions of emotion (sadness, happiness, surprise, anger, fear, and disgust), in addition to a neutral expression. *FaceReader* gives a real-time intensity rating of the displayed expression and provides a summary of the overall most dominant emotion(s). The algorithm is based on the Facial Action Coding System and has been trained with more than 10.000 annotated images (Noldus, 2015). The advantage of using commercial software such as *FaceReader* is that emotional experiences can be tracked over time. As opposed to facial EMG, nothing needs to be attached to the face so that the research question is not likely to be revealed up to the point where participants are debriefed. The emotion categories are predetermined in the software. No information about emotional experiences has to be assessed through language, which makes this method useful for cross-cultural application. As distinct facial patterns are associated with distinct emotion categories, their spontaneous and involuntary nature indicates that information about emotion induced by a musical stimulus is displayed. As opposed to facial EMG, automated face analysis is not invasive or limited to a small number of muscle movements that can be assessed at the same time. It allows for assessing the face as a whole and thus get a new perspective on how emotions evoked by music develop over time (Kayser, 2016, 2017 (under review)).

V. DISCUSSION

When studying emotions in music and especially music-induced emotion, traditional methods such as self-report and physiological measurements may not provide reliable data. Reasons are that there is no strict use of the terminology and categorization of 'emotion', 'emotional feeling' and 'feeling', which is crucial for the selection of research methods. In addition, methods for using perceived emotion in music and music-induced emotion occasionally overlap.

The state-of-the-art methods that have been used for the last decades are vulnerable to demand characteristics and researcher bias, which leads to unreliable results and misleading conclusions. Applying a method that uses a second-person description of musical experience may help avoiding some of the flaws that are characteristic to the first- and third person description of musical experience. One method that can be applied for getting a better understanding about the nature and development of emotions induced by music is automated face analyzes. The spontaneous

manifestations of an emotional experience occur automatically and thus function as a mirror for an underlying emotion. Due to the suggested universality of facial expressions of the basic emotions, this would allow for studying this phenomenon cross-culturally without the ambiguity of language and the barriers it creates. In addition, it would shed light on strong emotional experiences that listeners fail to describe with words, and get new insights on emotional experiences in populations suffering from certain medial and psychiatric illness where the feedback loop that 'translates' an emotion into a feeling is disrupted. Alexithymia, meaning 'no words for feelings' (Sifneos, 1973), for example, is a condition where the ability to identify one's feelings is disrupted. The alexithymic trait is suggested to be prevalent in 13% of the general population (Salminen, Saarijärvi, Aarela, Toikka, & Kauhanen, 1999). If more than 10% of the general population are not able to identify their feelings and express them through language, any form of first-person description is reaching its limitations. Using facial expressions of emotion for studying music-induced emotion in favor to more traditional approaches may thus help getting new insights on experienced emotion in general and music-induced emotion in particular. Future research will reveal if this method is able to fill some of the gaps that self-report and physiological measurements are not able to fill.

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