This is a transcript of the following paper:

Title: A framework for examining emotion perception in tone quality: theory and future application
Author: Kristal Spreadborough
Conference: International Symposium on Sensory Cognition 2021
Date: November 26, 2021
DOI for this presentation: 10.26188/17067956

This transcript should be read in conjunction with the AV presentation to which it is attached and which shares the same DOI.

Structure

Table of Contents

Abstract

A sounds tone quality, its unique sound characteristic or tone colour, can be a highly salient emotional cue. It can at once convey the literal source of a sound, evoke abstract interpretation, and signify socially constructed meaning. Tone quality plays an important role in musical expression. Its potential to convey literal, abstract, and social meanings may render it a salient emotional cue in music. However, how, and the degree to which, tone quality impacts emotional perception in music is not well understood. One reason is that the variety of characteristics that comprise tone quality can be challenging to quantify and isolate in an empirically and ecologically valid way. This paper presents a framework for theorising emotional expression in tone quality and outlines how the theory may inform future empirically grounded approaches. Drawing on previous research in music psychology, social semiotics and multimodality, this paper outlines a set of discrete tone quality features, and considers how different configurations of these features may convey different emotions. It presents an emotional model which can be used to interrogate emotional expression. In doing so, it presents a multimodal approach which integrates literal, abstract, and social meaning potentials of sound and considers how these contribute to emotional expression.

Key words: Tone quality, emotion, perception, expression, song, semiotics, voice

Towards a framework for examining emotion perception in tone quality: theory

and future application

1 Introduction.

Hello. My name is Kristal Spreadborough and I'd like to thank you today for having me along to this event. It's a real pleasure. I'd like to thank the organisers of this event who have invited us along and facilitated this to happen today. I recognise that different locations have different customs for acknowledging the traditional custodians of the land on which you may be sitting. In Australia it's common to do an acknowledgment of country at the beginning of a talk to pay respect to the traditional custodian of the lands on which we are currently situated ourselves in Australia. I myself am situated at the University of Melbourne and so I would like to acknowledge that I am gathered here with you on the lands of the Wurundjeri people of the Kulin Nation, who have been custodians of these unceded lands for many thousands of years. The University of Melbourne is situated on the lands of the Wurundjeri and Boon Wurrung, the Dja Dja Wurrung People, the Yorta Yorta Nation, and the Wadawurrung People. I would l like to acknowledge and pay my respects to their Elders past and present.

I'd like to start today by listening to some music. I'm going to play you a short clip form one of the pieces form which this study takes its inspiration. And I'd like you to think about this one questions as you're listening: How would you describe the tone quality in this music and its role in conveying emotion.

[musical example plays in presentation]

Keep your thoughts about this piece of music in mind for a few minutes. We can likely all agree that The quality of a sound can convey a lot of information to a listener. It can evoke the literal source of a sound (like a growl from a lion), an emotional response (like the

jolt from a scream of fear), and can signify a socially constructed meaning (like the collective understanding of church bells within particular communities). Sound quality, which I will hence forth refer to as tone quality, plays a key role in the expression and perception of emotion in music. However, there are as yet very few methods of annotating, analysing, and understanding how tone quality specifically contributes to emotional experience in song. It is form here that my study takes its starting point

I present a theoretical framework that can be used to annotate and analyse tone quality, but also to empirically investigate its role in conveying emotion. My earlier work looked specifically at voice quality in popular vocal songs and examined how the emotion conveyed through voice quality impacted emotional perception of lyrics. The current study examines tone quality in general and its role in emotion expression and perception.

Thinking back on the audio we just heard, take a moment to think about how you would describe the tone quality you heard, and how would you describe the way this tone quality influences your experience of the song. This recording was from an artist called EMA. It's a track from her 2014 album called Satellites. The track uses tone quality as an expressive mechanism, there are unique and novel sounds, there is a blurring of the human and non-human tone qualities, and there are references to our ecological experiences of sound. The goal of this paper is to present a framework that allows us to speak a similar language when we are describing tone quality and when we are discussing its role in emotion expression and perception. The aim is for this framework to be used for music analysis, but also for the investigation of the emotion of music from the perspective of music psychology.

Now I don't wish to labour this point too much, but I do think it is important for understanding the perspective of the theoretical framework I am presenting to be very clear that this work found its genesis in the desire to *analyse* tone quality. Specifically, it is focused on analysing tone quality from our lived experience of sound. That is, how do we understand

sound through all of our senses, and how do we bring this understanding into our musical experiences? My particular interest is modern, recorded, popular music. Artists such as EMA who use tone quality in compelling ways and as a mechanism for exploring and expressing our relationship with technology, with each other, and with our ecological contexts.

The theoretical framework is conceptualised with its application to such analysis always front of mind. For this reason, it may not be immediately apparent how one might operationalise certain elements of the framework in an empirical context. None the less, the framework *does* lend itself to such a line of enquiry, and there is a lot to gain for music studies more broadly in perusing this line of enquiry.

Before continuing, a note is required on how tone quality is defined. The figure you see on the screen is a high level conceptualisation of the theoretical framework. All sounds possess a sound quality. When applied to music, these sounds are expressed through musical elements. The combination of sound quality and musical elements is what I take to mean tone quality. The broken line between sound quality and musical elements demonstrates that while these are definable attributes of a tone quality, these are not discrete, wholly separate layers. Rather, they are dialectically related. That is, sound qualities may play a role in musical elements, and vice versa. Sometimes text is used in music which adds an additional layer to the framework, one which I will not be addressing here today.

The theoretical framing here is grounded in three primary disciplines: social semiotics, music studies, and music psychology. It is multimodal in nature, theorising across human and non-human sound predication, and considering the lived experience of sound as central to our understanding of emotion in tone quality in music.

We will first consider the model of emotion that underpins the discussion of emotion today before exploring the tone quality theorisation in more detail. We will conclude by

exploring how these features may be operationalised in an empirical context to better understand the psychology of emotion expression and perception in tone quality.

2. Emotion

I recognise that the expression and perception of emotion can be two distinct things. I've been using these terms together so far in this presentation, but for the remainder I'm going focus the discussion on emotion perception. In previous work and currently in work with other collaborators, I'm undertaking an experiment to determine the extent to which intended emotion expression aligns with the perceived emotion using a similar framework to the one we are discussing now. However for today, the focus is on theorising emotion perception in tone quality.

This framework draws on the locus of emotion as described by Evans and Schubert (2008), which refers listeners experiencing emotion in music either by *recognising* the emotion expressed by the music, called perceived or external locus of emotion; or through feeling a subjective *response* to the music, called felt or internal locus of emotion. This framework is focused on the external locus of emotion, that, on the emotions which may be *recognising* and *perceived* by the listener.

The discrete and dimensional models of emotion tend to be used in a great deal of music emotions research. The discrete model tends to focus on the basic human emotions and the dimensional model, although there are several, generally consider how emotion can be understood through Russell's 1980 valance and arousal system.

Some recent work has argued that dimensional models of emotion are better understood through three dimensions, rather than two. In their 2000 paper, Schimmack and Grob proposed such a model which included *tension arousal* (tense-relaxed), *energy arousal* (awake-tired) and *valence* (pleasant-unpleasant).

A 2011 study by Eerola and Vuoskokski examined how such a three dimensional model and discrete models interact when participants are actually asked to judged emotion in music. This work found that participants are able to consistently, accurately rate emotional musical stimuli on both the discrete and dimensional models, and that participants were also able to more accurately rate ambiguous emotions when using the dimensional model. In this way, a hybrid model may be useful for music emotions research in so far as a dimensional model can explain the under-lying affect space in music, and the discrete model can be used when one is consciously labelling emotions. It is such a hybrid model that underpins the conceptualisation of emotion in this framework.

The frmework tracks emotion using a system termed the Affect Map. Before explaining this in more detail, two more terms need to be defined – Affect and Mood. This is important for this theorieical framework because, recall, while we are discussing the framewor's application today in terms of how it might facilitate *emperical investigation* of emotion in tone quality, the framework has arisin from, and is focused on the need for, a system for analysing tone quality in muisc studies. In such analytical contexts one may find the need to discuss affect ans mood more generally. Therefore, these terms need to be accounted for within the theoretical framework.

Unlike emotions, which tend to be short lived affective states and emotion words tend to imply an object, moods are longer lived and mood words are not directed at. There is much debate in current music psychology literature about how music evokes moods, what kind of moods are evoked, and indeed where the boundary between emotion and mood lies in musical experience. However, it is generally agreed that regardless of the exact mechanisms and classifications, 1) music does induce mood and 2) mood is a more diffuse experience that is typically not directed at a target.

The term affect is used since it typically refers to overall reaction to music that encompasses both moods and emotions. In music specifically, affect is used as a term for describing individuals' responses to sound, although there is debate about how mood and emotion contribute to musical affect (Hunter and Schellenberg 2010, section 5.8). Since this theoretical framework is designed to account for both moods and emotions, the term Affect Map has been adopted here to describe the relationship between the two.

OK, with that additional context put around those terms, let's examine how the Affect Map can be used to theorise emotion in tone quality. The Affect Map provides a visual, dynamic representation of emotion and mood. Figure A displayed on your screen now is an example of a blank Affect Map which one might use to conceptualise emotion. Moods are denoted by squares and emotions are demoted by circles. Vallance is denoted by *colour*, which sits on a spectrum from white to black. *Arousal tension* and *arousal energy* lay along the x and y axis respectively. The Affect Map can be used to represent any number of emotions, as shown in figure B. In these figures, the placement of the emotions along the arousal and valance scales are my own. They are intended to be indicative only – a demonstration of how emotions can be placed onto the Affect Map. There are of course different levels of intensity of each emotion and the placement of emotions on the Affect Map can vary to demonstrate the varying levels of intensity. The placement of moods, demonstrated in figure C, can also vary along the scale. Presently, the graduation and placement of emotion and moods on the Affect Map is my own. However, however this hybrid approach to thinking about emotion for tone quality can be applied as a framework through which to operationalise emotion in an empirical context. When we talk more about the features that make up a tone quality shortly, we will be referring back to the Affect Map

as a way of hypothesising emotion expression – hypotheses for which the next step is to undertake empirical exploration.

3. Tone Quality Theorisation

Let's now look at the different features of a tone quality that are theorised within this framework to contribute to emotional perception. What you're seeing on your screen now is what I refer to as the tone quality features. They are separated into four components: onset, sustain, termination, and features that apply to all three phases. We're going to step through each of these features individually, but before we do this, it is worth taking a moment to address several points of clarification.

First, this framework presents a method of annotating and analysing tone according to a set of individual features. However, as will be seen shortly, the context, the configuration, in which these features occur is essential for understanding their implications for emotional perception. In this way, this framework draws on principals of Gastualt theory which contends that "the whole is something else than the sum of its parts" (Koffka, 1935, p.176 as cited in Jakel et al., 2016, p. 3). Why is this distinction important? The ability to taxonomize individual features of a tone quality is essential for music analysis, which recall is the inspiration of this work. It is also important to be able to detail how tone qualities differ at a granular level in order to clearly articulate how emotion conveyed. However, recognising the importance of the *configuration* of tone qualities is essential for understanding how one might apply this theoretical framework in an empirical context. It will be essential to examine tone quality in a way that is ecologically valid – that is, in a way that accounts for the different features but does not reduce a tone quality to a single feature.

Second, potential emotional meanings of the features described below are inferred from a semiotic perspective. Two sources of emotional meaning inform this approach: natural sources of meaning, and cultural sources of meaning. Natural sources of meaning are those that "arise from the way in which nature takes its course" (Hall, 2012, p. 8). Natural meanings are discovered by humans and may be perceived in an intersubjective way. For example, in general a scream indicates danger. Cultural meanings are "those we have invented to communication with each other in complex ways" (Hall, 2012, p. 9). Cultural meanings are constructed by society and individuals must learn the conventions for understanding and conveying these meaning. The hypotheses that will be posted about how each tone quality feature might be placed on the Affect Map are based on these two sources of emotional meaning. It is these hypotheses that can be the basis of future examination.

The remainder of this section will now examine each of the tone quality features individually.

3.1 Features which apply to onset, sustain, and termination

Close/far and Loud/soft are related to all parts of a sound. According to Moylan (2017) Loud/soft is related to performance intensity, which is "the loudness of the sound sources when … performed in the recording studio process" (p. 139). That is, the volume of the sound if one was standing in proximity to it. Close/far, on the other hand, is, according to Campbell and Greated (2001) concerned with the perceived intensity of a sound in the mix, that is, the recording or mix of sounds in the performance. In this way, close/far is more about "the context in which the sound is heard" (para. 1). Taken together, Close/far and Loud/soft may relate to distance and power. van Leeuwen, 1999, proposes that loud sounds may be associated with strength and importance. Softer sounds may signify less power and gentleness. These significations may be subverted or reinforced by their graduation on the

close/far scale. Sounds which are loud and close, that is positioned close to the listener in the mix and high in volume, may signify physical and social proximity. However, sounds which are loud and far may signify diminished power, or impending threat. The table on your screen provides vocal and non-vocal examples of sounds which contain these features and their potential placement on the affect map.

High variability/low variability refers to how much change there is in features from one word or phrase to the next. Assessments of irregularity are not made in relation to an absolute reference point, but rather in relation to the surrounding use of that feature. It may be identifiable at the level of the beat, bar, or phrase. For example, a tone quality that consistently employed vibrato within a phrase would not be considered to have high variability, however one that varied from extreme plain to extreme vibrato between beats would be considered irregular. Juslin and Laukka (2003) found that microstructural irregularity was associated with the basic emotions of anger, fear, and sadness (i.e. negative emotional states), while regularity was associated with happiness and tenderness (i.e. positive emotional states). Going beyond the basic emotions, it is proposed in this paper that irregularity could also be associated with nervousness and anticipation, which are not necessarily negative but are states of uncertainty. Therefore, in this paper, I contend that high levels of variability signify uncertainty, while low levels signify certainty. The table on your screen shows examples of variability in vocal and non-vocal sounds and their placement on the affect map.

3.2 Onset

Moving on now to onset.

The framework presented here conceptualises onset tone quality in terms of three features which are graduated on a bipolar scale. Fast onset/slow onset refers to the speed at which the sound is initiated. A fast onset requires a lot of energy for the rapid initiation of sound, a slow onset requires less energy. Irregular onset/regular onset refers to whether the initial part of the sound is "noisy" or "rough". According to van Leeuwen (1999) in the human voice these effects come "from the aperiodic vibration of the vocal cords which causes noise in the spectrum" (p. 132). Aperiodic vibrations characterise irregular onsets in other sound sources too. Hard onsets/soft onsets refer to the force with which the note is delivered. A hard onset is one in which the initial sound is accented and strongly delivered, creating a percussive effect, a soft onset is one in which no accenting of the sound occurs. Hard onsets must also be faster, but not all fast onsets are hard. Similarly, soft onsets can be slower, but not all slow onsets are soft. The features of hard/soft and fast/slow can occur independently of the feature irregular/regular onset. The table on your screen show different examples of hard and soft onsets and their placement on the affect map.

3.3 Sustain

Next, let's look at sustain. There are 10 individual tone quality features that can contribute to emotion perception in this this theoretical model. We're going to step through these, briefly, one at a time. As before, you will see on your screen a table containing examples of each feature, and it's hypothesised placement on the affect map.

Tense/lax

Tense/lax sounds are created by varying the amount of effort used to produce a sound. In vocal sounds, "to sound tense, one constricts the muscles in the body, particularly the throat; to sound lax one relaxes these muscles". Tense sounds, both vocal and non-vocal, are constrained and narrow. The exact quality of a tense sound depends on its configuration with

other features – for example tense sounds that are also low produce a different overall quality to ones that are produced at high pitch ranges. Tense sounds may signify states that need resolution, such as uncomfortable or unsure emotional states, since much effort is needed to produce sounds and this effort is not easily sustained for long periods of time.

Nasal/non-nasal

Nasal/non-nasal sounds are those that have the quality of the sound undergoing cul-de-sac oscillation. For vocal sounds, nasal sounds can be produced through tensing muscles and through allowing air to escape only through the nose or mouth (van Leeuwen, 1999, p. 136). Nasality may signify unusual and uncomfortable states such as sarcasm (Plazak, 2010, as cited in Huron, 2015, p. 190), and submission (Lomax, 1968 as cited in van Leeuwen, 1999, p. 137).

Vibrato/plain

Vibrato, according to Rossing, 1990, is "a family of tonal effects in music" that is created by "periodic vibrations of one or more characteristics in the sound wave" (p. 134). This is true of both vocal and non-vocal sounds. What vibrato/plain sounds signify is heavily context dependent. In some cases, vibrato may signify warmth and love, whereas in others it may signify fear and quivering.

High/low

High/low refers to the pitch of the tone. Sounds sources which have shorter vibrating airstream, vocal folds, or membrane will produce a higher pitch, and vice versa for lower sounds. Sounds produced outside of their usual register may signify dominance and assertiveness. For example, according to van Leeuwen, 1999, men speak higher, women

speak lower, to convey authority. High/low sounds may impact the production of other tone features, for example falsetto in the singing voice results in a very different overall tone quality to non-falsetto singing.

Regular vibration/irregular vibration

Regular/irregular vibration refers to whether or not we can hear things in the sound other than the tone quality itself. It refers to how rough or noisy a tone quality is. As we discussed with onset, this is generally the result of "aperiodic vibration causing noise in the spectrum" (Laver, 1980, p. 128 as cited in van Leeuwen, 1999, p. 132). Irregular vibration in this way may signify negative emotions. For example, a scream is irregular and noisy, and a scream may be considered negative. The configuration of irregular tone qualities with other features results in very different tonal effects. For example, high, breathy, tense, and irregular, may signify a scream, where as low, clear, lax and irregular may signify a growl.

High levels of audible inhale/low levels of audible inhale and high levels of audible exhale/low levels of audible exhale

High levels of audible inhale/low levels of audible inhale and high levels of audible exhale/low levels of audible exhale are both referring to how breathy a sound is. They are mutually exclusive for a single sound. That is, usually a sound cannot audible inhale and exhale at the same time. These features apply both to the use of breath when producing sound, such as a breathy voice, and in between sounds, such as an inhale between phrases. Breathy sounds may represent a variety of emotive states and thus are heavily dependent on context. For example, breathiness may signify closeness, as one needs to be physically close to a sound source to hear breath. Breathiness, according to Poyatos (2002), may also be

associated with the "uncontrollable nonverbal expression of sexual arousal". I also suggest that breathiness in the voice may indicate vulnerability. For example, a sobbed utterance or the ragged breathy quality of a fearful voice. One must examine how this feature is configured with others to determine its overall emotional meaning.

Resonant/non-resonant and high reverb/low reverb

Resonant/non-resonant refers to how much presence a tone quality has. A resonant sound may have a ringing quality that caries the sound over other sound sources. A resonant sound has many sounding harmonics in the spectrum. Resonance may be associated with power and control. High reverberation and low reverberation is similar to resonance in this framework, except that it is more to do with the environment in which the sound is produced, rather than the quality of the sound production itself. Reverberation refers to the presence of the "echo" effect. Low reverberation creates a dry effect. The presence of reverberation can create a feeling of distance and space, whereas a sound which is dry and low in reverberation may imply closeness.

Distorted/clear

Distorted sounds are those that are in some way altered from the intend sound. For example, distortion is experienced by those suffering from hearing loss, distortion may happen over the telephone of there is a poor connection or speaker quality, or distortion may occur in recordings or technologically mediated sound production where sounds are too loud and clipping occurs. Because distortion represents a deviation from the norm, a distorted sound may be associated with uncomfortable, negative emotions. It is unique in the tone quality features as it is almost exclusively a technologically facilitated tone quality effect. However, and again reflecting the position of this framework as one which is focused on the

analysis of music such as that which we heard at the start of the presentation, it is included here since it is a prominent tone quality feature.

3.4 Termination

Finally, let's examine termination. The duration of a termination ranges from very short to very long. Termination is measured across one tone quality feature – clear/tapered. A clear termination is one that has a strong ending; a tapering termination is one in which the sound slowly fades, allowing for other elements (such as noise) to become present. Tapered terminations may be associated with negative emotional states, while a clear termination may be associated with positive emotional states. Take, for example, the ragged speech of a distraught individual compared to the fast, clipped chatter of a happy child.

To summarise, this section has explored how tone quality is theorised as comprising of discrete tone quality features. With the exception of close/far, loud/soft, and high/low variability, these features have been categorised into onset, sustain, and termination. Sustain has the most potential for variation in tone quality features, being analysed across 10 individual features. We'll now explore some of the considerations for operationalising these features, and the Affect Map, in an empirical context.

4. Operationalising in an Empirical Context

So, what are the next steps for validating this theoretical framework?

The first consideration is whether all of the features described here play a role in emotion expression and perception. For example, there is a great deal of support for the role of some features in conveying, such as loudness and pitch. However, the role of others is as yet less well defined. Indeed, is it the case that some several features could in fact be the same construct? For example, do audible inhale and audible exhale play a different role in emotion expression and perception, or could they be accounted for under a single feature of

audible breath? How should one use this information to inform the application of the framework for music analysis?

Second, to what degree is intended emotion expression accurately decoded by the listener? For example, is a singer uses a particular configuration of tone quality features to express sadness, is this same configuration decoded as sadness by the listener? To what extent might this be culturally bound or not, given this framework's focus on natural and cultural meanings? When using this understanding to inform the application of this framework music analysis, one need to take care that emotion expression and perception are adequality teased out so that empirical understandings are accurately applied.

 Third, how does one operationalise each tone quality feature while remaining true to the ecological context of the sound. Indeed, to what extent can tone quality features be extracted from their context? this is one of the most challenging aspects of examining tone quality – that the features are often inextricably linked to other features, and that their quality can change as a function of their context. We may need to consider investigating configurations of features, rather than features individually, something which would be in line with the application of the framework to music analysis.

Finally, the Affect Map provides hybrid model which can be used to structure how we ask participants to rate emotion, and can provide participants with a tool to more explicitly express their ratings. The Affect Map presents an opportunity to examine three layers of emotion perception: a dimensional one, a discrete one, and a more high level impression of mood. The way that participants interreact with the Affect Map, and the way it is deployed in studies, can shape it's application in music analysis – perhaps bringing it more in line with how participant, who represent music listeners, think of emotion in music.

In summary, this paper aims to outline a theoretical framework for investigating emotion in tone quality. At its heart, it is concerned with music analysis, especially the

analysis of modern popular music. It is conceptualised at the nexus of music studies,

semiotics, and music psychology. Having now been articulated, we can now seek to validate

aspects of the framework through future investigation. Thank you for your time, and please

do get in touch if you would like to discuss this topic further.

5. References

Eerola, T., and J.K. Vuoskoski. 2011. "A comparison of the discrete and dimensional models

    of emotion in music." *Psychology of Music* 39 (1): 18-49.

    https://doi.org/10.1177/0305735610362821.

Eerola, Tuomas, and Jonna K. Vuoskoski. 2013. "A Review of Music and Emotion Studies:

    Approaches, Emotion Models, and Stimuli." *Music Perception* 30 (3): 307-340.

    https://doi.org/10.1525/MP.2012.30.3.307.

Evans, Paul, and Emery Schubert. 2008. "Relationships between expressed and felt emotions

    in music." *Musicae Scientiae* 12 (1): 75-99.

    https://doi.org/10.1177/102986490801200105.

Hall, S. 2012. *This means this this means that: A user's guide to semiotics.* Laurence King

    Publishing.

Hunter, Patrick G., and E. Glenn Schellenberg. 2010. "Music and Emotion." In *Music*

    Perception, edited by Mari Riess Jones, Richard R. Fay, and Arthur N. Popper,

    36:129–64. Springer Handbook of Auditory Research. New York, NY: Springer New

    York. https://doi.org/10.1007/978-1-4419-6114-3_5

Huron, D. 2015. "The Other Semiotic Legacy of Charles Sanders Peirce: Ethology and

    Music-Related Emotion." In *Music, Analysis, Experience: New Perspectives in*

    Musical Semiotics, edited by C. Maeder and M Reybrouck, 185 - 208. Belgium:

    Leuven University Press.

Jäkela, F., Singhb, M., Wichmanncd, F. A., and Herzoge, M. H. 2016. "An overview of

quantitative approaches in Gestalt perception." *Vision Research* 126: 3-8.

https://doi.org/10.1016/j.visres.2016.06.004

Juslin, Patrik N., and Petri Laukka. 2003. "Communication of Emotions in Vocal Expression

and Music Performance: Different Channels, Same Code?" *Psychological Bulletin*

129 (5): 770–814. https://doi.org/10.1037/0033-2909.129.5.770.

Moylan, W. 2007. *The Art of Recording: Understanding and Crafting the Mix*. Oxford,

United Kingdom: Focal Press.

Poyatos, F. 1992. "The Audible-Visual Approach to Speech as Basic to Nonverbal

Communication Research." In *Advances in Nonverbal Communication: Sociocultural,*

Clinical, Esthetic and Literary Perspectives, edited by F. Poyatos, 41 - 58.

Amsterdam: John Benjamins Publishing Company.

Rossing, T.D. 1990. *The Science of Sound*. Reading, Massachusetts: Addison-Wesley

Publishing Company.

Russell, J.A. 1980. "A circumplex model of affect." *Journal of Personality and Social*

Psychology 39 (6): 1161–1178.

Schimmack, U., and A. Grob. 2000. "Dimensional Models of Core A?ect: A Quantitative

Comparison by Means of Structural Equation Modeling." *European Journal of*

Personality 14: 325-345.

van Leeuwen, T. 1999. *Speech, Music, Sound*. Palgrave Mcmillian.