JYVÄSKYLÄ STUDIES IN HUMANITIES
222

Anemone G. W. Van Zijl

Performers' Emotions in Expressive Performance: Sound, Movement, and Perception

JYVÄSKYLÄN YLIOPISTO

JYVÄSKYLÄ STUDIES IN HUMANITIES 222

Anemone G. W. Van Zijl

Performers' Emotions in Expressive Performance: Sound, Movement, and Perception

Esitetään Jyväskylän yliopiston humanistisen tiedekunnan suostumuksella
julkisesti tarkastettavaksi yliopiston vanhassa juhlasalissa S212
tammikuun 16. päivänä 2014 kello 12.

Academic dissertation to be publicly discussed, by permission of
the Faculty of Humanities of the University of Jyväskylä,
in building Seminarium, auditorium S212, on January 16, 2014 at 12 o'clock noon.

UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2014

Performers' Emotions in Expressive Performance: Sound, Movement, and Perception

JYVÄSKYLÄ STUDIES IN HUMANITIES 222

Anemone G. W. Van Zijl

Performers' Emotions in Expressive Performance: Sound, Movement, and Perception

UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2014

Editors
Geoff Luck
Department of Music, University of Jyväskylä
Pekka Olsbo, Ville Korkiakangas
Publishing Unit, University Library of Jyväskylä

Jyväskylä Studies in Humanities
Editorial Board

Editor in Chief Heikki Hanka, Department of Art and Culture Studies, University of Jyväskylä
Petri Karonen, Department of History and Ethnology, University of Jyväskylä
Paula Kalaja, Department of Languages, University of Jyväskylä
Petri Toiviainen, Department of Music, University of Jyväskylä
Tarja Nikula, Centre for Applied Language Studies, University of Jyväskylä
Raimo Salokangas, Department of Communication, University of Jyväskylä

Cover picture by Josef Jan Michnia.

URN:ISBN:978-951-39-5566-3
ISBN 978-951-39-5566-3 (PDF)

ISBN 978-951-39-5565-6 (nid.)
ISSN 1459-4323 (nid.), 1459-4331 (PDF)

Jyväskylä University Printing House, Jyväskylä 2014

Music is your own experience, your own thoughts, your wisdom.
If you don't live it, it won't come out of your horn.
- Charlie Parker

ABSTRACT

Van Zijl, Anemone G. W.
Performers' Emotions in Expressive Performance:
Sound, Movement, and Perception
Jyväskylä: University of Jyväskylä, 2014, 67 p.
Jyväskylä Studies in Humanities
ISSN 1459-4323 (nid.), 1459-4331 (PDF); 222
ISBN 978-951-39-5565-6 (nid.)
ISBN 978-951-39-5566-3 (PDF)

Performing musicians face the question of how to best achieve an expressive performance. Should they, for instance, feel the emotions present in the music, or should they rather rely on the use of appropriate technical means, such as tempo, dynamics, articulation, and timbre? Moreover, does their focus have an effect on the characteristics and perception of their performances? The research compiled in this thesis investigates the role of performers' experienced emotions in practice and performance, as well as the effect of performers' focus on the sound, movement, and perception of their performances. To this end, five studies were conducted encompassing a range of research methods.

Study I revealed that performers' emotions involved in the practice process consist of both perceived and felt emotions, the latter further subdivided into music-related and practice-related emotions. Importantly, the prevalence of performers' experienced emotions was found to change over the duration of the practice process. Studies II and III revealed that a focus on technique, expressivity, or felt emotions results in different movement and auditory performance characteristics. Study IV revealed that audience members preferred expressive performances to technical and emotional ones, but rated emotional performances as being most expressive of the intended emotion. Study V revealed that performers' emotions involved in the performance process consist of both performance-related and music-related emotions, the latter detailing a complex relationship between the performer and the music. Expressive and emotional playing were conceptualised differently. On stage, performers aimed for expressive playing rather than for emotional playing.

These findings indicate that performers' experienced emotions play a role in the practice and performance process of an expressive performance. In addition, they reveal that a performer's focus has a significant effect on both performance characteristics and audience perception. The research compiled in this thesis supports the validity of distinguishing between emotional and expressive playing, and is valuable for both research and artistic practice and pedagogy.

Keywords: performing musicians, felt emotions, expressive performance, performers' movements, audio features, audience perception

Author

Anemone G. W. Van Zijl
Department of Music
P.O. Box 35(M)
40014 University of Jyväskylä, Finland
anemone.vanzijl@jyu.fi

Supervisor

Dr. Geoff Luck
Department of Music
University of Jyväskylä, Finland

Reviewers

Professor Richard Ashley
Bienen School of Music
Northwestern University, USA

Professor Eric F. Clarke
Faculty of Music
University of Oxford, UK

Opponent

Professor Eric F. Clarke
Faculty of Music
University of Oxford, UK

ACKNOWLEDGEMENTS

From 2009 to 2013 I have had the privilege of being a doctoral student of the Finnish Centre of Excellence in Interdisciplinary Music Research. The Centre of Excellence provided the funding and infrastructure that made this research possible. Despite the endless winters, difficult language, and location far away from the rest of the world, I could not have wished for a warmer, more inspiring, or more supportive work environment. I would like to express my sincere gratitude to the wonderful people I have been able to learn from and work with, and who have been invaluable for the realisation of this doctoral thesis.

First I would like to thank my supervisor, Geoff Luck, for the support throughout my doctoral studies: Thank you for encouraging me to investigate the research questions that meant the most to me, for stimulating me to master new research skills, and for helping me to gain confidence as a researcher. I would like to express my gratitude to my former supervisor, John Sloboda: Thank you for helping me to specify my research topic, for the warm welcome I received at the Guildhall School of Music and Drama in London during a three month research visit in 2012, and for scientific guidance in general. I would like to thank the director of the Centre of Excellence, Petri Toiviainen: Thank you for the help with analysing audio and movement data, for creating such a warm and inspiring work environment, for the fun we had when playing your great musical arrangements, and for support and advice whenever needed. I would like to thank Olivier Lartillot: Thank you for helping me with analysing audio data, and developing new techniques to investigate my research questions.

I feel honoured that this thesis has been reviewed by two eminent scholars, Eric Clarke and Richard Ashley: Thank you for your helpful and valuable comments, and your acclaim of this thesis and its constituent publications. In addition, I would like to express my gratitude to Eric Clarke for agreeing to be my opponent at my doctoral defence.

In addition to my co-authors and reviewers, I would like to thank all other members – past and present – of the Centre of Excellence, both in Jyväskylä and Helsinki. Your friendship, support, feedback, and encouragement importantly contributed to the successful completion of this thesis. In particular, I would like to thank my office-mate, Birgitta Burger: Thank you for all the moral, motion capture, and computer support, and for all the discussions, mutual inspiration, and constructive procrastination. Sharing the whole experience of doing a PhD far away from home with someone who understands what it is all about has been really important to me. I would like to thank the coordinator of the Centre of Excellence, Markku Pöyhönen: Thank you for all the help with administrative concerns related to working and living abroad. I would like to express my thanks to the technicians, Mikko Leimu and Petteri Poutianen, for solving numerous computer problems. Further thanks go to my colleagues with whom I spent most time in countless lunch and coffee breaks, research seminars, article celebrations, dinners and drinks, sauna visits, jam sessions, and joint hours of travelling all the way to India, America, and Australia. Thank you Jonna Vuoskoski, Vinoo Alluri, Marc Thompson, Pasi Saari, Rafael Ferrer,

Suvi Saarikallio, Jörg Fachner, Jaakko Erkkilä, Tuomas Eerola, Marko Punkanen, Esa Ala-Ruona, Tommi Himmberg, Kaisa Johansson, Martín Hartmann, Henna Peltola, and Iballa Burunat. I would like to express additional thanks to Marc Thompson for help with Matlab programming, to Ben Meuleman for help with statistics, and to Jonna Vuoskoski and Henna Peltola for translating the abstract of this thesis into Finnish.

Without the musicians who participated in the various studies presented here, I would not have been able to write this thesis. I would like to thank the musicians – studying at, graduated from, or teaching at the Royal Northern College of Music in Manchester, Keele University, the University of Applied Sciences in Jyväskylä, the University of Jyväskylä, and the Guildhall School of Music and Drama in London – who were willing to share their knowledge, experience, and feelings concerning the preparation and accomplishment of a musically expressive performance.

I would like to thank my friends in Finland, for the warm-hearted company and all the activities we undertook, ranging from berry picking and rowing, to cross-country skiing and hunting for the northern lights. I would like to thank my friends in The Netherlands, for visiting me, staying in touch, and investing in our friendship despite busy lives in different countries. I would like to thank my music teachers for the inspiring lessons, which instigated my fascination for the relationship between music and emotion, and for the supply of oboe reeds, which enabled me to express my emotions through music.

Finally, I would like to thank my family. In particular my mother Marnel, father Werenfried, and brother Servaas. I would like to thank you for your unconditional love, endless support, humour, wisdom, and creativity, genuine interest in my work, and encouragement on a daily basis.

Jyväskylä, December 2013
Anemone Van Zijl

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following original publications, referred to in the text by Roman numerals (I-V).

I Van Zijl, A. G. W., & Sloboda, J. A. (2011). Performers' experienced emotions in the construction of expressive musical performance: An exploratory investigation. *Psychology of Music, 39(2)*, 196-219.

II Van Zijl, A. G. W., & Luck, G. (2013). Moved through music: The effect of experienced emotions on performers' movement characteristics. *Psychology of Music, 41(2)*, 175-197.

III Van Zijl, A. G. W., Toiviainen, P., Lartillot, O., & Luck, G. (in press). The sound of emotion: The effect of performers' experienced emotions on auditory performance characteristics. *Music Perception.*

IV Van Zijl, A. G. W., & Luck, G. (2013). The Sound of Sadness: The Effect of Performers' Emotions on Audience Ratings. In G. Luck & O. Brabant (Eds.), *Proceedings of the 3rd International Conference on Music & Emotion (ICME3)*, Finland: University of Jyväskylä.

V Van Zijl, A. G. W., & Sloboda, J. A. (2013). Emotions in Concert: Performers' Experienced Emotions on Stage. In G. Luck & O. Brabant (Eds.), *Proceedings of the 3rd International Conference on Music & Emotion (ICME3)*, Finland: University of Jyväskylä.

AUTHORS' CONTRIBUTIONS TO THE PUBLICATIONS

I The first author designed the study and Diary, collected and analysed the data, and wrote the article. The second author helped in shaping the research topic, design, and Diary, and proofread the article.

II The first author designed the study, collected and analysed the data, and wrote the article. The second author suggested which movement features to investigate, gave advice regarding the statistical analyses, and proofread the article.

III The first author designed the study, collected and analysed the data, and wrote the article. The second and third authors suggested which auditory features to investigate and how to extract them, and proofread the article. The fourth author gave advice regarding the statistical analyses, and proofread the article.

IV The first author designed the study, collected and analysed the data, and wrote the article. The second author gave advice regarding the statistical analyses, and proofread the article.

V The first author designed the study, collected and analysed the data, and wrote the article. The second author helped to facilitate the research, and proofread the article.

CONTENTS

1 INTRODUCTION

Music is often associated with emotions. Attending a performance that makes you feel like nothing else in the world exists, or that transports you to distant times and places of happiness, sadness, or longing, is an experience many people cherish. For some people, such an experience determines their life course: One day they will be the musicians who entrance the audience.

Although many questions regarding the emotional power of music have been investigated, the question of how performers move their audiences is still somewhat shrouded in mystery. It is often explained in terms of a performer's gift or talent, as something that cannot be taught or learned, and even as something that should not be spoken about (e.g., Kingsbury, 1988). As a result, music students often have to discover by themselves how the emotions they feel in relation to the music relate to their playing and the perception of their playing by an audience. In other words, the role of a performer's experienced emotions in achieving an expressive performance is unclear. Some musicians and researchers adhere to the vision that: "A musician cannot move others unless he too is moved" (C.Ph.E. Bach, quoted in Persson, 2001). Others argue that performing is more a matter of deliberate conscious awareness and planned expressiveness: "I also have to play pieces which are not so emotionally connected to me, because I am a professional" (pianist interviewed by Sloboda & Lehmann, 2001). According to Juslin: "… there are several ways in which emotion might enter into the performance of music: emotions might influence a performer's motivation, choice of repertoire, interpretation, and concentration, as well as the precise nature of the performance. However, there is little systematic knowledge about most of these processes" (2009, p. 377).

The overall aim of the research presented in this thesis is to investigate performers' emotions in expressive performance. Specifically, the research aims to explore the role of performers' experienced emotions in the construction and execution process of an expressive performance. The focus will be on emotions experienced in relation to the music. In addition, the research aims to investigate the effect of performers' experienced emotions on performance characteristics and audience perception of performances. This means that the thesis in-

corporates research focusing on the performer, the performance, and the audience – the prerequisites of an expressive performance.

The research presented in this thesis explicitly focuses on performing musicians: Musicians for whom the ultimate task is not just making music, but doing it for an audience. Some of the musicians involved in the research are accomplished amateurs; most are talented students at higher music institutions; and some are internationally renowned professionals. All of them are classically trained musicians. The research concentrates on solo performances or performances with a small ensemble, to ensure the performer's individual involvement regarding the interpretation of the music.

This thesis is situated in the interdisciplinary field of music psychology. Research in this field aims to investigate the multifaceted ways in which people engage with music and tries to explain the mechanisms underlying its powerful influence on behaviour. Music psychology comprises insights and approaches from a range of fields, including musicology, psychology, biology, sociology, anthropology, philosophy, psychoacoustics, neuroscience, cognitive science, and music therapy (Deutsch, 2012; Juslin & Sloboda, 2010).

The research presented in this thesis makes use of a range of methods: From interview and diary investigations utilised to provide an in-depth insight into the performers' perspective on the role of experienced emotions in practice and performance; to innovative experiments using state of the art recording and analysis techniques to provide concrete evidence that performers' experienced emotions affect the sound, movement, and perception of their performances.

This thesis is structured as follows. Chapters 2 and 3 present a review of relevant literature and provide working definitions of the main concepts used. Chapter 4 outlines the aims of the thesis. Chapter 5 provides a rationale for the research methods employed. Chapter 6 summarises the five studies included in the thesis. Chapter 7, finally, discusses the main findings, limitations, and implications of the thesis.

2 PERFORMERS' EMOTIONS IN EXPRESSIVE PERFORMANCE

Performing musicians face the question of how to best achieve an expressive performance. Should they, as proposed by Gabrielsson (2001-2002), feel the emotions perceived in the music; or rather rely on the use of appropriate technical means such as tempo, dynamics, articulation, and timbre; or perhaps adopt an intermediate position and "strive for emotional identification but still have some conscious control of performance" (p. 138)? As stated before, the opinions regarding the presence of performers' emotions in expressive performance differ. Some studies emphasise the importance of feeling the emotions (e.g., Persson, 1993, 2001; Lindström, Juslin, Bresin & Williamon, 2003), whereas others underline the idea of planned expressiveness (e.g., Sloboda & Lehmann, 2001; Chaffin, Imreh, & Crawford, 2002; Chaffin, Lemieux & Chen, 2006). In this Chapter, working definitions of the concepts "performers' emotions" and "expressive performance" will be provided, and literature addressing the role of performers' emotions in expressive performance will be reviewed.

2.1 Performers' Emotions

One of the main concepts used in this thesis is the concept of "performers' emotions". According to Gabrielsson (2001-2002), there is neither in everyday language nor in psychological terminology a unanimous agreement on the definition of terms such as "emotion", "feeling", "mood", and "affect". Some researchers state, for instance, that an "emotion" is a brief and intense affective reaction consisting of several sub-components, whereas a "mood" is an affective state that lasts longer, is less intense, and does not involve a synchronised response of several sub-components (e.g., Scherer, 2000). Other researchers state that a clear distinction between emotions and moods cannot be made, and suggest they might represent the opposite ends of a single continuum (e.g., Beedy, Terry & Lane, 2005). According to Juslin and Sloboda (2010), the term musical "affect" comprises everything from music preference, mood, and emotion, to

aesthetic or even spiritual experiences. As such, musical "affect" might have been the most appropriate term to use in this thesis. The more specific term "emotion", however, is generally used in music and emotion research despite the inclusion of a range of affective processes. Hence, in this thesis the term "emotion" is used rather than "affect".

An important distinction made in music and emotion research, however, is the distinction between induced and perceived emotions. The term "induced emotion" refers to someone's emotional response to the music: The music causes, for instance, a sad feeling. The term "perceived emotion" refers to the ability to perceive an expression in music – of, for instance, sadness – without necessarily being affected oneself (e.g., feeling sad) (Gabrielsson, 2001-2002). Several studies have investigated the relationship between perceived and induced emotions in listeners (e.g., Kallinen & Ravaja, 2006; Evans & Schubert, 2008; Lundqvist, Carlsson, Hilmersson & Juslin, 2009; Vuoskoski, 2012). The relationship between perceived (or performed) and induced emotions in performers, however, has received little attention so far.

In this thesis the concept of "performers' emotions" is used in a generic sense, and is meant to include all affective processes performing musicians experience during practice and performance.

2.2 Expressive Performance

The concept of an "expressive performance" can be understood in different ways (e.g., Clarke, 1988; Sloboda, 1996; Timmers & Honing, 2002; Juslin, 2001, 2003; Lindström et al., 2003). According to Lindström et al. (2003) "expression" can refer to systematic variations in acoustic parameters – such as tempo, dynamics, and articulation – that differentiate one performance of a piece of music from another; it can refer to the fact that music performances are perceived as expressive of emotion by listeners; and it can refer to the musical sensitivity of the performer, that he or she knows exactly how to play a given phrase (p. 24).

The systematic variations in acoustic parameters that differentiate one performance from another have been investigated in detail (e.g., Clarke, 1988). Clarke (1988), for instance, outlined a theory of expression consisting of generative principles explaining the systematic variations in timing, dynamics, and articulation in piano performance.

Although it can be debated as to whether music can be expressive of emotion (e.g., Kivy, 1990; Krumhansl, 1997), and whether emotions expressed through music are comparable to emotions in everyday life (e.g., Zentner, Grandjean & Scherer, 2008; Scherer & Zentner, 2008), many studies have investigated listeners' perception of emotions expressed through music (e.g., Gabrielsson & Juslin, 2003; Juslin & Laukka, 2003; Eerola & Vuoskoski, 2013), and the underlying mechanisms that might explain listeners' perception of emotions have received increasing attention as well (e.g., Juslin & Västfjäll, 2008).

The musical sensitivity of the performer and the potential involvement of the performers' emotions in generating an expressive performance, however,

have received far less attention (Woody & McPherson, 2010). Although several researchers have pointed towards a performer's sensitivity or emotional and empathic depth as a potential explanation for what gives a remarkable performance its special quality (e.g., Altenmuller & Schneider, 2009; Chaffin, Lemieux & Chen, 2007; Hallam, 1995; Juslin, 2001, 2009; Reid, 2001; Sloboda, 1996; Sloboda, Minassian & Gayford, 2003), few studies have investigated the role of performers' experienced emotions in expressive performance.

In this thesis, the concept of an "expressive performance" is understood in relation to the performer. It is defined as the (desired) outcome of the individual shaping of a piece according to the musical ideas of the performer.

2.3 Feeling the Music

Some studies suggest that performing musicians need to feel the emotions perceived in the music to be able to perform expressively. Lindström et al., for instance, administered a questionnaire to investigate how conservatoire students approach the subject of expressivity. They found that 44 percent of the students defined "playing expressively" largely in terms of "communicating emotions"; while 16 percent defined "playing expressively" in terms of "playing with feeling". According to Lindström et al., the first definition focuses more on actually conveying something to the audience, whereas the second focuses more on the performer's own feelings. According to 99 percent of the participants in the study, music can express emotions. The majority of the music students claimed that they feel the intended emotion while playing (always, 23%; often, 65%; seldom, 12%; never, 0%), and as many as 60 percent of the students regarded it as necessary to feel the emotion in order to communicate it successfully to a listener (Lindström et al., 2003).

Investigations into the techniques used by musicians "to feel the musical emotion" or "to get into the mood" of the piece being played, however, are scarce. To the author's knowledge, the only study specifically addressing such techniques is an unpublished doctoral dissertation by Persson (1993). Based on interviews with fifteen musicians, Persson suggests that some musicians consciously manipulate recall of certain memories (emotional memories and memories of emotions), either via a technique called "mood induction" (i.e., to remember the sensation of a certain emotion without necessarily conjuring up specific imagery), or via a technique called "visualization" (i.e., conjuring up visual imageries). In the context of music education research, the use and effect of techniques such as aural modelling (i.e., the teacher plays a phrase which is then repeated by the student), verbal instructions addressing concrete musical properties, and verbal instructions using imagery and metaphors used to teach students to play expressively have been investigated to a limited extent (Woody, 2000, 2002, 2006; Schippers, 2006; Karlsson, 2008).

In addition to the techniques used by musicians to get into the mood of the piece being played, in his doctoral dissertation, Persson (1993) investigated the role of emotion regarding performers' motivations to perform, as well as

regarding factors that influence the generation of musical performance. As regards motivational aspects to perform, he identified four motives. The first motive is labelled "hedonic" (i.e., the pleasurable experience involved in playing music), the second "social" (i.e., meeting and socialising with other musicians), the third "exhibitionistic" (i.e., the desire to share the music and your understanding of it), and the fourth "achievement" (i.e., the desire to achieve something). The first motive represents most clearly the role of emotions in a performer's motivation to perform. It could be linked to more recent investigations into peak (e.g., Whaley, Sloboda & Gabrielsson, 2009; Gabrielsson, 2010) and flow experiences (e.g., Csikszentmihalyi, 1990), and positive and negative feelings including pleasure (e.g., Lamont, 2012) and anxiety (e.g., Kenny, 2010) that performers might experience when performing. The latter aspects have been investigated in more detail in studies focusing on motivation (e.g., Sloboda, 2001; O'Neill & McPherson, 2002; Woody & McPherson, 2010). Although the research presented in this thesis addresses the role of emotion regarding performers' motivation to perform to some extent, the focus of enquiry is on the role of performers' emotions in relation to an expressive performance.

As regards factors that influence the generation of musical performance, Persson (1993) identified four components, which are labelled: "noodynamic reference" (i.e., performers consciously construct a descriptive context for the music, a framework that directs how the music is played), "hedonic emotional reference" (i.e., performers tend to construct their interpretation so as to create an optimal level of pleasure when playing), "music structural reference" (i.e., the influence of the musical structure on the way the piece should be performed), and "conflict component" (i.e., a discrepancy between how performers believe tradition expects them to play certain music and how they would like to play that music). Surprisingly, the components influencing the generation of musical performance as identified by Persson have not been systematically investigated and confirmed in later studies (Woody & McPherson, 2010).

2.4 Performing the Music

Other studies propose that an expressive performance is – rather than feeling the emotions – more a matter of deliberate conscious awareness and planned expressiveness. These studies emphasize that musicians study musical texts, experiment with different interpretative devices and make deliberate decisions regarding the incorporation of specific expressive devices before the actual performance takes place (Chaffin, Imreh & Crawford, 2002; Sloboda & Lehmann, 2001).

Sloboda and Lehmann (2001), for instance, developed a method to link expert musicians' interpretive choices and associated performances to listeners' perception of emotionality. Sloboda and Lehmann found, among other things, that the trajectory of continuous responses of perceived emotionality followed the general structure of the musical score. Moreover, they found that many of the analysed divergences that were noticed by the listeners were reflected in the

performers' interpretive intentions as indicated in practice reports and short interviews (Sloboda & Lehmann, 2001).

Chaffin, Imreh and Crawford (2002) investigated the learning process of a piece of music by an expert pianist. Chaffin et al. identified six stages in the process of learning to play a piece from memory. The stages identified are called "scouting it out" (i.e., playing through the whole piece at the beginning of the first practice session in order to identify the main structure of the piece), "section by section" (i.e., working through the piece section by section, making decisions about fingering, practicing technical difficulties, and establishing motor memory), "the gray stage" (i.e., making the execution of earlier decisions fully automatic, while paying attention to both technical difficulties and interpretational concerns), "putting it together" (i.e., playing straight through the music from memory, incorporating everything worked on during the earlier sessions), "polishing" (i.e., slow practice and playing for practice audiences to refine the interpretation and build up confidence to perform the piece in public) and "maintenance" (i.e., playing through the piece every now and then to keep the piece ready for performance) (Chaffin et al., 2002, pp. 239–246).

In addition, Chaffin et al. concluded that expert musicians learn a piece of music by studying and thinking in terms of "performance cues". Chaffin et al. distinguished "basic cues" (e.g., critical fingerings, technical difficulties), "interpretative cues" (e.g., critical phrasings, dynamic emphases) and "expressive cues" (e.g., the musical feelings the performer wants to convey to the audience, such as surprise or excitement). It could be assumed that emotions are mainly at play regarding the construction of expressive cues. However, as with Sloboda and Lehmann (2001), Chaffin et al. (2002) do not address the role of the performer's experienced emotions concerning the interpretative and expressive decisions taken.

In sum, the role of performers' experienced emotions in the construction and performance process of an expressive performance is not clear. What complicates the matter is that in some studies (e.g., Woody, 2000; Karlsson & Juslin, 2008) emotional and expressive playing are considered as being one and the same. According to Juslin: "… the term 'emotional expression' is now widely established, and has been used in both cases where the expression is 'spontaneous' (genuinely felt) and where it is 'symbolic' (portrayed)"(2009, p. 378). Although in music and emotion research so far no distinction has been made between genuinely felt and portrayed expression of emotions, in other fields the question of whether they result in similar vocal, facial, and bodily expressions has been debated (e.g., Erickson, Yoshida, Menezes, Fujino, Mochida & Shibuya, 2006; Bachorowski & Owren, 2003; Spackman, Brown & Otto, 2009; Banse & Scherer, 1996; Zuckerman, Hall, DeFrank & Rosenthal, 1976; Crane & Gross, 2007; Wallbott, 1998). In addition to investigating how performers try to achieve an expressive performance, and whether approaches such as those proposed by Gabrielsson (2001-2002) result in different performance characteristics, the research presented in this thesis explores the views of performing musicians on potential differences between felt and portrayed emotional expression in music.

3 SOUND, MOVEMENT, AND PERCEPTION

Does it make a difference as to whether performing musicians feel or express the emotions perceived in the music? To investigate the potential effect of performers' experienced emotions on the expressivity of a performance, in the research presented in this thesis the sound characteristics, movement characteristics, and perception of performances are examined. To the author's knowledge, only two studies investigating the effect of performers' emotions on performance characteristics have been published to date (Higuchi, Fornari & Leite, 2010; Glowinski, Camurri, Volpe, Chiarra, Cowie, McMahon, Jaimovich & Knapp, 2008). Before discussing these studies, some relevant literature regarding the investigation of sound characteristics, performers' movements, and audience perception will be reviewed.

3.1 Sound

Music consists first and foremost of sound. In music research, a distinction is often made between structural features of the music and performance features (Gabrielsson, 2009). Structural features, such as mode, rhythm, and harmony, are related to the score. In classical music, performers are not supposed to change the structural features of the music. Performance features, such as timing, vibrato, and timbre, are related to the performer. Many features, such as tempo, articulation, and dynamics, however, can be denoted both as structural and performance features. When examining the effect of performers' experienced emotions on the expressivity of a performance, only the features that may be modified by performers are of interest.

The performance features most commonly described in the literature are tempo, timing, articulation, dynamics, timbre, and vibrato (e.g., Gabrielsson & Juslin, 1996; De Poli, Rodà & Vidolin, 1998; Juslin, 2000). Although most of these features can be analysed by means of manual annotation (e.g., estimating the note onsets and offsets as a measure of timing), or modelling (e.g., modelling the vibrato of a note with a sinusoid), the analysis of performance features has

benefitted greatly from technological developments. In particular, the development of the MIR Toolbox (Lartillot & Toiviainen, 2007) – a MATLAB based toolbox comprising functions that can be adapted to extract features from a large quantity of audio files – has been important in facilitating the computational extraction and analyses of performance features.

The performance features associated with the musical expression of emotions such as happiness, sadness, anger, fear, and tenderness have been described in detail (Juslin, 2009). Sadness for instance, is characterised by features such as a slow tempo, low sound level, moderate sound level variability, legato articulation, small articulation variability, dull timbre, slow tone attacks, slow vibrato, and small vibrato depth (Juslin, 2009, p. 382). The features employed by a performer to communicate a certain emotion are found to be probabilistic rather than deterministic: Different performers can communicate emotions equally well despite differences in the performance features modified (e.g., Juslin, 2000).

As mentioned before, it is unclear as to whether felt and expressed emotions result in similar performance expressions. The literature on vocal expression of emotions might be informative in this regard. In an innovative study, Erickson et al. (2006) investigated the acoustic and articulatory (i.e., the settings of the lips, tongue, and lower jaw measured via Electro Magnetic Articulography) characteristics of spontaneously produced sad speech, imitated sad speech, imitated intonation speech, and read speech. They found that the voice quality of spontaneous and imitated sad speech were similar to each other, but differed from the read and imitated intonation conditions. In addition, the average durations of the imitated sad speech utterances were longer than those of the spontaneous, read, and imitated intonation speech. The authors suggest that this might be because the speakers expected sad speech to be slow, which might have influenced their speech production. In terms of articulatory characteristics, imitated sad speech was found to be similar to read and imitated intonation speech, rather than to spontaneous sad speech. The authors suggest that the different pattern of articulation may be not for the purpose of conveying sadness, but the by-product of experiencing sadness. Of particular interest is their finding that imitated sad speech received higher ratings of sadness than spontaneous sad speech. The authors suggest that there may be a set of stereotypes of what constitutes sad speech, which are not necessarily the same as those actually present in spontaneous sad speech. In sum, there seems to be a difference between felt and expressed vocal expression of emotion.

Based on a review of 104 studies of vocal expression and 41 studies of music performance, Juslin and Laukka (2003) conclude that vocal and musical expression of emotions show similarities in the accuracy with which discrete emotions can be communicated to listeners and the emotion-specific patterns of acoustic cues used to communicate each emotion. Important to note, however, is that none of the studies of music performance reviewed looked at the effect of felt emotions on performance expressions. All studies used portrayal, manipulated portrayal, or synthesis methods. Of the vocal expression studies included, 7 used mood induction procedures, and 12 used natural speech examples. The remaining ones used emotion portrayals by actors and manipulations of such

portrayals. According to Erickson et al. (2006), these methods are problematic: "Using actors in emotion studies will give results on paralanguage and not results on emotion as such. Therefore, to study emotional characteristics of speech (articulatory phonetics etc.) researchers need to move away from using actors." As outlined in Chapter 2, in the case of music performance it is not clear whether performers aim to feel the emotions perceived in the music, or to perform them by focusing on appropriate technical means such as tempo, dynamics, articulation, and timbre. In addition, it is not clear whether a different focus on the part of the performer results in differences in performance features.

3.2 Movement

In addition to the sound of music, performers' movements have received increasing attention in recent years. In a pioneering study, Davidson (1993) found that there is sufficient perceptual information contained in performers' kinematics to permit the identification of so-called "deadpan," "projected," or "exaggerated" performances. Accordingly, researchers have explored the movements of performers in a variety of settings (e.g., Davidson, 2001, 2007; Davidson & Correia, 2002; Williamon & Davidson, 2002; Kurosawa & Davidson, 2005). Although the commonly applied manual annotation and categorisation of performers' movements recorded on video is especially informative for the understanding of performers' behaviour on stage, the method cannot identify more subtle differences in performers' movements, such as the exact amount or speed of a performer's movements in a series of similar performances. The development of optical motion-capture systems and of analysis tools such as the MoCap Toolbox (Toiviainen & Burger, 2010) – a MATLAB based toolbox comprising functions that can be adapted to extract features from a large quantity of motion capture files – has been important in facilitating the computational extraction and detailed analyses of performers' movements.

Thompson and Luck (2012), for instance, investigated the kinematic characteristics exhibited in "normal," "deadpan," "exaggerated," and "immobile" performances of pianists recorded with an optical motion-capture system. They examined the amount of movement as well as velocity and acceleration contours of different body parts such as the hips, lower and upper back, head, shoulders, elbows, wrists, and middle fingers, across performance conditions. They found, for example, that the head and shoulders exhibited more movement and larger differences between performance conditions, as compared to the fingers, wrists, and lower back, which they explained in terms of biomechanical factors related to playing the piano, and performers equating playing without expression to playing without non-essential movements. Other studies have used motion-capture to investigate performers' playing technique (e.g., Schoonderwaldt, 2009), ancillary movements (e.g., Wanderley, 1999, 2002; Wanderley, Vines, Middleton, McKay & Hatch, 2005), and performers' movements in relation to the musical structure (e.g., MacRitchie, 2011). The influence

of performers' experienced emotions on their movement characteristics, however, has yet to be examined.

As regards the question of whether felt and expressed emotions result in similar performance expressions, the literature on bodily expression of emotions might be informative. In a study investigating the specificity of body movements and postures for certain emotions, Wallbott (1998) asked actors to portray 14 emotions (such as "elated joy," "happiness," "sadness," "despair," and "fear") and coded the positions of the upper body, as well as the quality of the movements in terms of activity, expansiveness, and energy. In the case of the portrayal of sadness, he found that actors chose a collapsed body posture, and that their movements scored low in terms of activity, expansiveness, and energy. In a study investigating the effect of induced emotions on gait characteristics, Crane and Gross (2007) used an autobiographical memory paradigm to elicit four different emotions ("anger," "sadness," "contentment," and "joy") in students before investigating their gait characteristics in terms of kinematic features. They found that a slower speed, lower amplitude of upper extremity motion, lower range of motion in the shoulders, elbows and hips, and a downward orientation of the head and upper body characterized sadness. These studies provide some evidence that portrayed and induced emotions result in similar bodily expressions.

Research in the field of sports psychology investigating the effect of performers' focus of attention on motor skills, however, suggests that a different focus results in differences in motor performance (e.g., Wulf, 2013). Research in this field has consistently demonstrated that an external focus (i.e., on the movement effect) enhances motor performance and learning relative to an internal focus (i.e., on body movements). In line with this research, Duke, Cash, and Allen (2011) examined the effect of differences in performers' focus on the consistency of piano playing. Their results supported the notion that an external focus (e.g., on the sound of the piano) resulted in more consistent playing than an internal focus (e.g., on the fingers). Although music performance is not just about playing a phrase as quickly and evenly as possible, it seems plausible that a performer's focus on, for instance, technique, expressivity, or felt emotions results in differences in performers' movements.

3.3 Perception

A large number of studies have investigated listeners' perception of music (Sloboda, 1988; Juslin & Sloboda, 2010). Many studies have, for instance, investigated listeners' ability to recognize emotions expressed through music (e.g., Gabrielsson & Juslin, 2003; Juslin & Laukka, 2003; Eerola & Vuoskoski, 2013). In such studies, individuals are typically asked to listen to musical excerpts and indicate which emotion the music expresses or induces via a forced choice, adjective ratings, free labelling, or continuous response format. In these studies, emotions tend to be conceptualised as discrete categories (e.g., "happy" or "sad") or as dimensions (e.g., "valence" and "arousal"). The musical stimuli

used are often excerpts of well-known classical compositions, film music, or especially composed musical phrases. As mentioned before, listeners tend to be highly accurate in recognizing the intended emotion (Juslin, 2009). In some of the studies, musicians are asked to express different emotions in subsequent performances of the same musical phrase. Unfortunately, in most of these investigations, neither the question of how musicians approach this task, nor the question of whether such a research set-up bears any resemblance with how performers usually try to achieve an expressive performance are addressed. The conclusion that can be drawn from these studies, however, is that performers are generally able to reliably communicate discrete emotions to listeners, and that the performance features used are probabilistic rather than deterministic (Juslin, 2009).

Several perception studies indicate that visual aspects such as movement characteristics, stage behaviour, physical appearance, and even a performer's dress are very important for the experience and judgement of a performance by an audience (e.g., Armontraut, Schutz & Kubovy, 2009; Davidson, 1993; Juchniewicz, 2008; Platz & Kopiez, 2013; Tsay, 2013; Wapnick, Mazza & Darrow, 1998; Schutz, 2008). In order to exclude the influence of aspects such as the performer's gender or physical appearance on audience perception, most investigations focusing on performers' or conductors' movements make use of point-light-technique representations (e.g., Davidson, 1993) or motion-capture animations (e.g., Wanderley, 1999, 2002; Dahl & Friberg, 2007; Thompson & Luck, 2012; Luck, Toiviainen & Thompson, 2010). Also, research indicates that auditory stimuli may be perceived differently when coupled with different visual stimuli (e.g., Juchniewicz, 2008; Vines, Krumhansl, Wanderley, Dalca & Levitin, 2011). As a result, when investigating the effect of performers' experienced emotions on their performances, it is important to distinguish between auditory and visual performance characteristics and, in case of an interest in performers' movements, use visual representations that do not reveal aspects such as the performer's gender or physical appearance.

As stated before, only two studies addressing the effect of performers' experienced emotions on the resulting performances have been published to date. Higuchi et al. (2010) subjected nine pianists to a sadness-inducing mood induction procedure before they performed a piece for four-hands by R. Schumann – with the main researcher as co-performer – once while focusing on each note, and once while thinking of the emotional stimuli. Higuchi et al. found that participants played more legato and with less metric precision in the emotional playing condition. Glowinsky et al. (2008) subjected two violinists to a mood induction procedure before they performed several pieces by J.S. Bach in an angry, sad, joyful and peaceful manner. Analyses of audio, video and physiological recordings revealed differences in the duration of the performances, differences in heart rate, galvanic skin response, and tension in the right arm. The differences, however, were not specified in relation to the performance conditions.

The research conducted for this thesis aimed to improve the experimental designs used in the studies by Higuchi et al. (2010) and Glowinski et al. (2008) by focusing on solo performances rather than four-hand piano performances,

using musical stimuli that are congruent with the induced mood, applying mood induction techniques that musicians tend to use themselves when preparing for performance, and using state of the art audio and motion-capture recording and analyses techniques to provide detailed evidence as to whether performers' experienced emotions affect the sound and movement characteristics of their performances. In addition, to the author's knowledge, this thesis includes the first perception study investigating the effect of performers' experienced emotions on audience perception of performances.

4 AIMS OF THE THESIS

The overall aim of this thesis is to investigate the role of performers' emotions in expressive performance. Specifically, the aim is to answer the following research questions:

1. What is the role of performers' experienced emotions in the practice and performance process of an expressive performance?

2. What is the effect of performers' experienced emotions on performers' movement characteristics, auditory performance characteristics, and audience perception of performances?

Five Studies were conducted in order to answer the above research questions. Studies I and V address the first research question. More specifically, Study I investigates the way music students construct a musically expressive performance and the role their emotions play within the construction process. Study V investigates what role performers' experienced emotions play in performance. Studies II, III, and IV address the second research question. More specifically, Study II investigates the effect of performers' experienced emotions on their movement characteristics. Study III investigates the effect of performers' experienced emotions on auditory performance characteristics. Study IV investigates the effect of performers' experienced emotions on audience perception of performances.

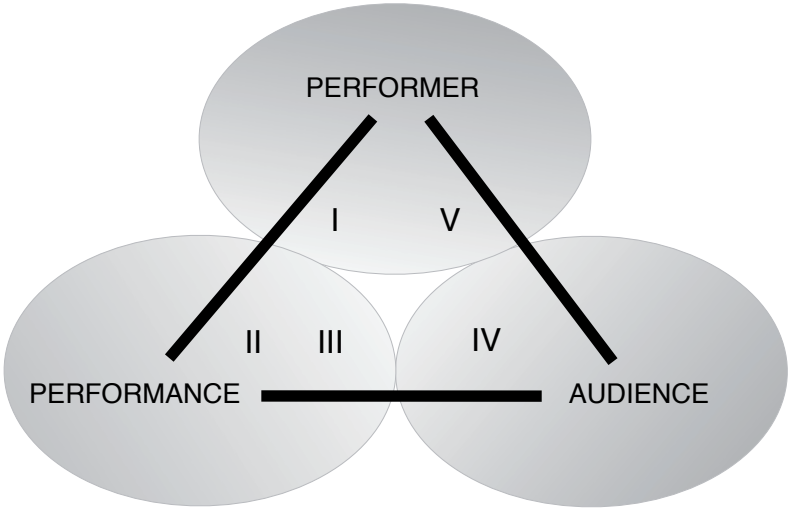

FIGURE 1 Representation of the Studies included in the thesis in relation to the three prerequisites of an expressive performance.

The prerequisites of an expressive performance are the performer, the performance, and the audience. As illustrated in Figure 1, this thesis incorporates these three aspects as follows: Studies I and V focus on the performers' perspective, answering the first research question utilising predominantly qualitative research methods. Studies II and III focus on performance characteristics and Study IV on audience perception, answering the second research question utilising predominantly quantitative research methods.

5 METHODOLOGY

What distinguishes this thesis is the range of research methods employed. Qualitative and quantitative methods are used in a complementary and integrated way to investigate the topic of performers' emotions in expressive performance in its full complexity.

Different studies were conducted to answer the research questions mentioned before. Although one of the qualitative studies includes a quantitative element, and all quantitative studies include a qualitative element, the investigation of the first research question focusing on the performer's perspective reflects a predominantly qualitative methodology, whereas the investigation of the second research question focusing on performance characteristics and audience perception, reflects a predominantly quantitative methodology. The research materials, procedures, and analyses techniques are described in detail in Chapter 6 as well as in the original publications. This Chapter provides a rationale for the research methods employed.

5.1 Qualitative Approaches

The first research question – What is the role of performers' experienced emotions in the practice and performance process of an expressive performance? – is investigated in Studies I and V. These studies provide an in-depth insight into the performers' perspective using predominantly qualitative research methods.

Traditionally, qualitative research methods are linked to the assumptions of a qualitative research paradigm. These assumptions are that knowledge is subjective, and constructed by the individuals involved in the research. The research process is inductive rather than deductive. Concepts and their definitions evolve during the course of the research. The research typically takes place in a natural setting and results in large amounts of detailed, rich data. In data analyses, the focus lies in the discovery of patterns or theories that help explain the phenomenon under investigation (Creswell, 1994, p. 4-7).

As outlined in Chapter 2, little is known about the role of performers' experienced emotions in the practice and performance process of an expressive performance. As a result, the research investigating these processes has to be of an exploratory nature and inductive rather than deductive. Performing musicians are the experts when it comes to the construction and delivery of an expressive performance. In addition, the emotions they might experience are of a personal, inner nature. To explore performers' experienced emotions and their role within practice and performance, a qualitative approach based on the principle of asking performers themselves for answers was considered most suitable.

The aim in Study I was to investigate the role of performers' experienced emotions during the practice process of an expressive performance. The research design consisted of three parts: An introductory, semi-structured interview; a monitoring period during which participants completed a practice Diary; and an in-depth, semi-structured interview based on experiences described in the Diary. The monitoring period during which participants completed a specially designed Diary was included for two reasons. The first reason was to ensure that participants would reflect on recent, concrete, and consciously monitored practice experiences, something deemed necessary given the complexity of concepts such as emotions and expression. The second reason was to aid triangulation, a powerful technique that facilitates validation of data through cross verification from two or more sources (O'Donoghue & Punch, 2003). To check whether completing the Diary influenced the participants' opinions, some questions were asked during both the first and second interview. The data were analysed in a systematic way using complementary strategies including content analysis (Tonkiss, 2004), qualitative thematic analysis (Seale, 2004), and constructionist analysis (Walsh, 2000). The findings were verified through respondent validation (Walsh, 2000).

The aim in Study V was to investigate the role of performers' experienced emotions during the performance process. The research design consisted of an in-depth, semi-structured interview in which participants reflected on a recent performance experience, created a visual representation of the experience, and answered some general, reflective questions. In addition to aiding triangulation, the visual representation encouraged participants to reflect on their experience in a different way. This often caused participants to identify the core concepts within their experience and to detect missing aspects. The data were analysed in a systematic way using complementary strategies including qualitative thematic analysis, constructionist analysis, and iconographic analysis (De Visser, 1986; Berryman, Smythe, Taylor, Lamont & Joiner, 2002). In this study, nineteen musicians were interviewed, which resulted in approximately 400 pages of interview transcripts, and, moreover, a clear example of data saturation. Saturation is the point in data collection when no new or relevant information emerges with respect to the data already collected (Saumure & Given, 2008). Given the large amount of data, only part of the findings relating to the qualitative thematic analysis are included in this thesis.

Although qualitative methods were considered best to explore the inner state of the performer, they are not appropriate for an investigation of the effect

of performers' experienced emotions on actual performances. To answer the second research question, quantitative methods were utilised.

5.2 Quantitative Approaches

The second research question – What is the effect of performers' experienced emotions on performers' movement characteristics, auditory performance characteristics, and audience perception of performances? – is investigated in Studies II, III, and IV. Using predominantly quantitative research methods, these studies provide concrete evidence that performers' experienced emotions affect the sound, movement, and perception of performances.

Traditionally, quantitative research methods are linked to the assumptions of a quantitative research paradigm. These assumptions are that knowledge is objective, and independent of the individuals involved in the research. The research process is deductive rather than inductive. Concepts and variables are chosen and strictly defined before the start of data collection. The research typically takes place in a laboratory setting and results in numerical data to be analysed through statistical testing. The aim is to develop generalizations that contribute to existing theory and that enable one to better predict, explain, and understand the phenomenon under investigation (Creswell, 1994, p. 4-7).

The Studies included in this thesis are reported in chronological order. This means that the experimental designs of Studies II, III, and IV were based on the findings of Study I. In Study I, a difference was proposed between "emotional playing" and "expressive playing". To further examine and objectify the difference proposed in Study I, two experiments were conducted.

In the first experiment, addressed in Studies II and III, performers' were asked to play the same musical phrase in response to three different performance instructions. The first instruction was to focus on the technical aspects of their playing. The second instruction was to give an expressive performance. Following a sadness-inducing mood induction task, the third instruction was to play while focusing on their felt emotions. Performers' mood was assessed through the Positive and Negative Affect Scale (PANAS) state questionnaire (Watson, Clark & Tellegen, 1988) administered before and after the mood induction procedure took place. Performers' musical backgrounds and preparation of the musical phrases were investigated through a background questionnaire. After each performance condition, the performers were interviewed about their thoughts and feelings experienced while playing. High quality audio and three-dimensional motion-capture recordings were made of 72 performances (8 performers x 3 performance conditions x 3 performances).

The intention was to make the experimental design as ecologically valid as possible. To this end, the performance instructions and mood-induction procedure were based on techniques musicians tend to use when preparing for a performance (Juslin, 2003; Persson, 1993, 2001). In addition, the induced mood (i.e., sadness) was congruent with the emotional quality of the music selected for performance as implied by its structural features (i.e., minor mode, legato

articulation, slow tempo indication). The effectiveness of the mood-induction procedure was verified both via a standardized measure to assess people's mood (i.e., the PANAS state questionnaire), and via interview questions. Inclusion of the qualitative element (i.e., interviewing the performers after each recording session) increased the reliability of the design and validity of the recordings: The accounts of the performers ensured that they had been able to follow the instructions as intended.

Performers' movements were recorded with an eight-camera optical motion-capture system. The system recorded the 3-dimensional position data of 33 reflective markers attached to the body and instrument of each participant at a sampling rate of 120 frames per second. This resulted in extremely accurate and detailed data of performers' movements. The movement data were analysed in terms of the total distance travelled, speed, acceleration, and jerk (i.e., the rate of change of acceleration) of individual body parts as well as performers' overall movement. In addition, changes in body posture were estimated and the potential effect of playing tempo on movement characteristics was taken into account. Statistical analyses, including repeated-measures ANOVAs with Bonferroni-corrected post-hoc pair-wise comparisons, independent t-tests, and simple linear regression, were carried out to investigate differences in performers' movement characteristics between performance conditions.

High quality audio recordings were made using software and a directional microphone surrounded by a reflection filter. For reference purposes, video recordings were made with four video cameras. The audio recordings were analysed in terms of tempo (i.e., performance duration, duration of each bar, and coefficient of variation of the bar durations), articulation (i.e., attack slope estimated for each note), dynamics (i.e., root mean square energy (RMS) both per performance and per bar, and difference between minimum and maximum RMS of the bars of each performance), timbre (i.e., mean spectral centroid and mean roughness), and vibrato (i.e., relative vibrato depth and vibrato rate of the eight longest notes of each performance). Statistical analyses, including repeated-measures ANOVAs and mixed-design ANOVAs with Bonferroni-corrected post-hoc pair-wise comparisons, and independent t-tests, were carried out to investigate differences in auditory performance characteristics between performance conditions.

Sophisticated computational analyses of the recordings revealed differences between performances played with a different focus. However, the question remained as to whether these differences were salient enough to influence audience perception of performances. To examine this, a second experiment was conducted.

In the second experiment, addressed in Study IV, 36 performances (4 performers x 3 performance conditions x 3 presentation modes) of the first experiment were presented to 30 participants. The performances were presented in three blocks. In the first block, motion-capture animations were shown without sound (i.e., Vision-only). In the second block, only the audio recordings were played (i.e., Audio-only). In the third block, the motion-capture animations were shown with sound (i.e., Vision & Audio). The participants were instructed to rate how much they liked each performance, how skilled they thought each

performer was, and to what extent each performance was expressive of sadness by indicating their agreement with three statements on a seven-point bipolar scale (completely disagree – completely agree). After rating all performances, participants were instructed to write down any comments they had about the study and their experiences. Statistical analyses, including repeated-measures ANOVAs with Bonferroni-corrected post-hoc pair-wise comparisons, and Pearson's Correlation Coefficients, were carried out to investigate participants' preference, perceived skill of the performer, and perceived expression of sadness of performances played with a focus on technique, expressivity, or felt emotions.

Research into cross-modal interactions of visual and auditory perception has shown that participants' ratings can be affected by the mode in which a stimulus is presented (e.g., Juchniewicz, 2008; Vines et al., 2011). To anticipate this, and to be able to distinguish between the influence of performers' movements (as represented in the Vision-only mode) and auditory performance characteristics (as represented in the Audio-only mode) on participants' ratings, each performance was presented in three presentation modes. As regards the task given to participants, one possibility was to ask them to rate the extent to which they thought the performer was focusing on technical, expressive, or emotional aspects of playing. Although this would have directly answered the question of whether the differences between performance conditions revealed in Studies II and III are salient enough to influence audience perception of performances, this task was eventually considered to be too artificial. Liking a performance, believing that the performer is skilled, and perceiving the performance as being expressive of the intended emotion, are judgement criteria that more closely approximate audience experiences of a concert performance.

The combination and integration of qualitative and quantitative research methods adds scope and breadth to the thesis. In addition, the investigation of different aspects of the same phenomenon through different methodologies enables triangulation of the findings. The findings that performing musicians distinguish between emotional and expressive playing (Study I), that a focus on technique, expressivity, or felt emotions results in different movement and auditory performance characteristics (Studies II and III), that audience members prefer expressive performances but rate emotional performances as most expressive of the intended emotion (Study IV), and that performing musicians aim for expressive playing (Study V) were obtained through different research approaches but explain the phenomenon of performers' emotions in expressive performance in a congruent way.

6 SUMMARIES OF STUDIES

The five studies included in this thesis are summarised below. Studies I and V investigate the performers' perspective. Studies II, III and IV investigate the effect of performers' experienced emotions on movement characteristics, auditory characteristics, and audience perception of performances.

6.1 Study I: Performers' Emotions in Practice

6.1.1 Aim

Study I aimed to gain a deeper insight into the way music students construct a musically expressive performance and, in particular, the role performers' experienced emotions might play within the construction process. To this end, participants completed an introductory interview, a monitoring period during which they kept a Diary, and an in-depth interview based on the Diary.

6.1.2 Methods

Participants
Eight music students completed all parts of the study. The sample contained string, keyboard, woodwind and brass players. All of them were classically trained musicians. Three music students were tracked at the initial stage of practice on a piece of music, and five music students were tracked at the final stage of practice on a piece of music.

Materials and Procedure
The aim of the first part, consisting of an introductory, semi-structured interview, was to familiarize participants with the research procedure, collect some demographic data, and investigate their motivation to play the chosen composition as well as their definitions of concepts such as "expressive performance" and "emotional playing". Some of the questions were asked again during the

second interview to investigate whether the experience of completing the Diary influenced the participants' opinions. The interview lasted approximately 25 minutes. All interviews were recorded and transcribed verbatim.

During the second part, participants monitored their practice and performance of a piece of music by completing a Diary for a period of approximately a week. The Diary was specially designed for this study. A Diary sheet consisted of six columns named "Location", "Interpretation", "Technical Issues", "Inner Techniques", "Musical Emotion" and "Own Emotion". Participants were asked to complete a Diary sheet during or immediately after each practice session in which they played the piece. In addition, they were asked to perform the piece in a music lesson, and describe their experience of such a trial performance in the Diary. The Diaries were used as starting point and input for the in-depth interviews.

The third part consisted of an in-depth, semi-structured interview based on recent experiences described in the Diary. The in-depth interview lasted approximately 60 minutes and consisted of introductory questions, specific questions based on the descriptions provided in the Diary, and general questions. The introductory questions (e.g., "How did you find it to complete the Diary?") were included to encourage participants to talk. The specific questions (e.g., "How to show 'the linear line of the piece'?", "What do you mean with 'play with a smile'?") asked for elaboration upon and explanation of aspects described in the Diary. These questions were different in each interview. The interview ended with some general questions, such as: "How did your felt emotions relate to the perceived emotions in the music?" The idea behind these general questions was to obtain a summary of the main viewpoints of each participant. All interviews were recorded and transcribed verbatim.

Analyses

The data were analysed in a systematic way using three complementary strategies. The Diaries were analysed by means of content analysis: A method for studying textual data that seeks to analyse texts in terms of the presence and frequency of specific terms, narratives or concepts (Tonkiss, 2004). For each column of the Diary, the descriptions were listed, categorised and counted. The interview transcripts were analysed by means of qualitative thematic analysis. This involves an interpretative analysis of textual meaning based on a coding scheme derived both deductively from pre-existing concerns, questions and hypotheses, and inductively from examination of the actual data (Seale, 2004). The third strategy of analysis performed was a constructionist analysis (Walsh, 2000): By means of examining the episodes described in the Diaries and the explanations provided in the interviews, the interrelation between the elements involved in the construction process of an expressive performance was investigated. By means of respondent validation (Walsh, 2000), the findings of the three complementary strategies of analyses were verified.

6.1.3 Results

Systematic analyses of the Diaries and interview transcripts revealed a detailed insight into the way music students construct a musically expressive performance. The Diary was found to act as a successful tool to investigate performers' practice sessions. In addition, the Diary was found to be an effective practice device. Content analysis of the individual columns of the Diary revealed that the participants used no less than 12 different "inner techniques" to construct an interpretation with the desired emotional expression. The three inner techniques most often described were labelled "imagination" (e.g., thinking in terms of metaphors, visualising the musical narrative, impersonating different musical characters), "focus on sound/tone colour" (e.g., trying to create a specific sound), and "body movement" (e.g., moving along with the music). Another interesting finding was that participants made use of very subtle characterizations (e.g., "thoughtful", "dark", "still"; "cheeky", "witty", "humorous") when describing the emotions present in the music, whereas they described their own emotions in a less subtle way (e.g., "happy", "sad", "calm", "tense").

The relationship between the "musical emotions" and "own emotions" columns of the Diary was complex. With regard to the participants' own emotions, a difference was found between emotions related to the practice activity and emotions related to the music. Emotions related to the practice activity were either positive (e.g., "Yay – I can play it"), negative (e.g., "Frustration!"), or neither (e.g., "Remain calm"). Emotions experienced in relation to the music were either in line with the perceived musical emotions (e.g., Musical Emotion: "happy"; Own Emotion: "happy"), or caused by but different from the emotions present in the music (e.g., Musical Emotion: "melancholy and sad"; Own Emotion: "peaceful, happy"). All participants experienced both music-related and practice-related emotions. Moreover, it was found that the experienced emotions of the performers changed over the duration of the practice period.

Four phases in the construction process of an expressive performance were identified. In Phase 1, the initial exploration of the piece, performers explored the piece in a technical and emotional way by playing it through, while focusing on perceived and felt music-related emotions. In Phase 2, the mastering of technical difficulties, performers focused on practising shorter sections of the music, while felt emotions relating to the practice activity prevailed. In Phase 3, the construction of an expressive interpretation, participants at first tried to bring their felt emotions in line with the emotions they perceived in the music, by applying different "inner techniques". As the learning process developed, participants found appropriate technical means (e.g., using a particular bowing or type of vibrato) to translate their feelings into expressive music. Importantly, once participants had figured out these technical means, their music-related felt emotions waned. "Feeling" the musical emotions transformed into "knowing what to do" in order to convey them. In Phase 4, the construction of an expressive performance, performers allowed themselves to feel some music-related emotions again, while largely adhering to the previously constructed interpretation detailing the skills and knowledge of appropriate musical features, and while being aware of the act of performing.

6.1.4 Discussion

Study I aimed to investigate the relationship between performers' experienced emotions and the construction of a musically expressive performance. This relationship was explored through qualitative in-depth interviews based on recent practice experiences monitored by means of a Diary.

The findings add in a meaningful way to the findings of previous research. The finding that emotional engagement seems to be central during the process of constructing an expressive performance – at least in case of the music students who took part in this study – is in line with findings by Persson (1993; 2001) and Lindström et al. (2003), suggesting that musicians believe that a performer has to experience certain emotions in order to be able to perform in an expressive way. The finding that appropriate musical means were used, conventions regarding musical structure and style were followed, and that the expressive interpretation was constructed in detail before the actual performance took place, is in line with findings by Sloboda and Lehmann (2001) and Chaffin et al. (2002; 2006), suggesting that an expressive performance is a matter of deliberate conscious awareness and planned expressiveness.

The most important finding of the present study – which was not anticipated by previous research – seems to be that the role of a performer's experienced emotions changes over the duration of the practice period. In the construction process of an expressive performance, four phases were identified. During the first phase – the initial exploration – music-related emotions were present. During the second phase – the mastering of technical difficulties – practice-related emotions prevailed. During the third phase – the construction of an expressive interpretation – music-related emotions came to the fore. As learning proceeded, performers discovered and mastered appropriate technical means to translate their feelings into expressive music, and the intensity of their music-related felt emotions waned. During the fourth phase – the construction of an expressive performance – performers largely relied on their previously constructed interpretation while they allowed themselves to feel the music-related emotions to some extent.

Future research should investigate these findings in more detail, and test their generality on a larger and more diverse sample. In particular, the role of performers' experienced emotions during performance requires further investigation, as does the difference between "emotional" and "expressive" playing. In addition, it is not clear whether there is a perceptible difference between a performer who actually feels the music-related emotions, and a performer who delivers an expressive performance without feeling them. Studies II, III and IV address the last question, while Study V returns to the performers' perspective.

6.2 Study II: Performers' Movement Characteristics

6.2.1 Aim

Study II aimed to investigate the effect of performers' experienced emotions on their movement and postural characteristics. To this end, performers were asked to play a musical phrase in response to three different instructions – focus on technique; focus on expressivity; focus on experienced emotions. Amount, speed, acceleration, and smoothness of performers' movements, both overall and for individual body parts, as well as body posture, were subsequently compared across conditions. In addition, the effect of performance duration on the movement and postural characteristics was investigated.

6.2.2 Methods

Participants
Eight violinists (4 professionals and 4 accomplished amateurs) participated in the study. The professionals and amateurs were similar in terms of gender, age, and years of playing. They differed in terms of years of lessons, practice hours per week, and number of performances per year.

Musical stimuli
The two musical phrases used in the study were a 14-bar phrase in G minor with tempo indication *Lento ma non troppo*, and an 18-bar phrase in A major with tempo indication *Grazioso e con moto* from the British composer Sir Hamilton Harty (1911). The composer and title of the pieces were removed from the score. The analysis focuses on the first "sad" phrase. The second "happy" phrase was mainly included because of ethical considerations: To help ensure that participants were in a positive mood at the end of the data collection procedure.

Apparatus
An eight-camera optical motion-capture system (manufacturer: Qualisys) with a sample rate of 120 frames per second was used to record the 3-dimensional position data of 33 reflective markers attached to the body and instrument of each participant. Audio recordings of the performances were made using ProTools8 software (manufacturer: Avid) and a Microtech Gefell M300 directional microphone surrounded by an SE Electronics Reflection Filter. For reference purposes, video recordings were made with four video cameras (manufacturer: Sony).

Materials and Procedure
To assess their current mood, participants first completed the PANAS state questionnaire (Watson, Clark & Tellegen, 1988). Three recording sessions then followed, in which each participant was asked to play the first "sad" phrase at least three times in response to each of three different performance instructions.

The first instruction was: "While playing, try to focus on the technical aspects of your playing: so, think for instance about the rhythm, think about the dynamics, and think about the articulation." After the first recording session, participants were interviewed about their performances. They were asked which performance was most representative for the instruction given; what they thought about while playing; whether it felt natural to them to play while thinking about the instruction; and how they felt while playing.

The instruction for the second recording session was: "Play as you would normally play while giving an expressive performance." Subsequently, the same interview questions as listed above were asked.

Before the third recording session, a two-part mood induction task was administered. Participants were told that the phrase was taken from a piece of music written by a British composer, shortly after he had lost his four-year-old son. Participants were asked to imagine how this happened while listening to a story describing the evening the composer lost his son. In addition, participants were instructed to think of an intense sad emotional experience. They either wrote a few lines about their experience, or told the experimenter about it. The mood induction tasks were inspired by findings in the literature (Juslin, 2003; Persson, 1993, 2001). Subsequently, participants were asked to play the phrase in response to the third instruction: "Think about the emotional experience you've just written/told about. Try to feel the emotions of grief, of great sadness expressed by the music. Don't think about your playing, just focus on the emotions."

Following the third recording session, participants completed the PANAS state questionnaire again, to assess whether their mood had changed after the mood induction procedure. Then, the same interview questions as listed above were asked.

After the participants had completed a background questionnaire, they were debriefed: The composer of the music did not have a son, he was just happily married. To put the participants into a happy mood again, they completed a final recording session in which they played the second "happy" phrase, and received two movie tickets.

Finally, participants were asked what they thought about the experiment; what they thought were the differences between their performances; what their best recording session was (i.e., in relation to which instruction) and why they thought so; and whether there was anything they wanted to add or ask. Data collection lasted approximately 90 minutes per participant.

Movement feature extraction

Using the MATLAB Motion Capture Toolbox (Toiviainen & Burger, 2010), the number of markers was reduced from 33 to 25, and total distance travelled, speed, acceleration, and jerk were estimated from the position data of the reduced marker set-up.

Total distance travelled was estimated by summing the changes in position of each marker, and served as a measure of overall amount of movement. Speed was estimated by calculating the first time derivative of the position data. Acceleration was estimated by calculating the second time derivative of the po-

sition data. Jerk was estimated by calculating the third time derivative of the position data, and served as a measure of smoothness of movement.

Analyses
Differences in body posture, amount, speed, acceleration, and smoothness of movement were analysed via one-way repeated-measures ANOVAs, and post-hoc pair-wise comparisons with Bonferroni correction for multiple comparisons. Differences between amateurs and professionals were analysed via independent t-tests. The influence of performance duration on the movement features was examined via simple linear regression analyses with performance duration as predictor variable, and amount, speed, acceleration, and jerk of movement, respectively, as outcome variables.

6.2.3 Results

Body posture
The position of the body (torso) was investigated by examining changes in y-angle of the root-to-neck-segment. The main effect of performance condition on body posture was significant, with participants standing most upright in the Expressive condition, bent slightly backwards in the Technical condition, and bent further back in the Emotional condition. Post-hoc pair-wise comparisons revealed a significant difference in body posture between the Expressive and Emotional conditions only. No significant difference in body posture was found between the amateurs and professionals.

Amount of movement
The main effect of performance condition on amount of movement was significant, with post-hoc pair-wise comparisons revealing significant differences between all performance conditions. The average amount of movement was highest in the Expressive condition, lowest in the Technical condition, and in between in the Emotional condition. The amateurs moved significantly more than the professionals.

Speed of movement
The main effect of performance condition on speed of movement was significant, with post-hoc pair-wise comparisons revealing significant differences between the Technical and Expressive, and Expressive and Emotional conditions only. The average speed was highest in the Expressive condition, lowest in the Emotional condition, and in between in the Technical condition. The professionals moved faster than the amateurs, although the difference was not statistically significant across all markers.

Acceleration of movement
The main effect of performance condition on acceleration of movement was significant, with post-hoc pair-wise comparisons revealing significant differences between the Technical and Expressive conditions, and the Expressive and Emotional conditions only. The average acceleration was highest in the Expres-

sive condition, lowest in the Emotional condition, and in between in the Technical condition. Professionals moved with significantly higher acceleration than the amateurs.

Smoothness of movement
The main effect of performance condition on smoothness of movement (i.e., converse of jerk) was significant, with post-hoc pair-wise comparisons revealing significant differences between the Technical and Expressive, and Expressive and Emotional conditions only. The average smoothness was highest in the Emotional condition, lowest in the Expressive condition, and in between in the Technical condition. The amateurs moved significantly smoother than the professionals.

6.2.4 Discussion

Study II aimed to investigate the effect of performers' experienced emotions on their movement characteristics. To this end, performers were asked to play a musical phrase in response to three different instructions. Performers' body posture as well as the amount, speed, acceleration, and jerk of their movements were analysed.

Each performance condition revealed a different pattern of movement characteristics. In the Technical performances, the performers moved least, with medium speed, medium acceleration, and medium smoothness. In the Expressive performances, performers moved most, fastest, with most acceleration, and with lowest levels of smoothness. In the Emotional performances, performers moved with a moderate amount of movement, lowest speed, lowest acceleration, and highest levels of smoothness.

The patterns of movement characteristics seemed to indicate that a focus on technique or felt emotions resulted in more introverted playing, whereas a focus on expressivity resulted in more extraverted playing.

That performers moved more, and more distinctly, when playing expressively supports the findings by Davidson (2007), Thompson and Luck (2012), and Wanderley (2002). That performers moved with more accelerated and jerkier movements might be due to articulation of the musical structure, indicating important parts in the music (such as the beginning of a phrase) by means of more body movement. This supports the findings by Thompson and Luck (2012), Vines, Wanderley, Krumhansl, Nuzzo, and Levitin (2004), and Wanderley et al. (2005). Performers also moved fastest in the Expressive performances. In violin playing, the speed of the bow (along with bow-pressure and distance from the bridge) affects the loudness and timbre of the sound. Usually, faster movements (when keeping the bow-pressure and distance constant) result in a more intense sound (Gerle, 1991). Measurements of the average loudness of each performance indicated that participants indeed played louder in the Expressive performances as compared to the Emotional and Technical ones.

Differences in movement characteristics were also found between the performances of the amateur and professional performers. The amateurs moved more, but more slowly, more smoothly, and with less acceleration than the pro-

fessionals. These differences might be explained by differences in technical skill: Less skilled players might have chosen a slower tempo to ensure that they could cope with the technical demands of the phrase. Overall, the amateurs moved more than the professionals. This finding might be related to a certain efficiency of movement: Professional players may make fewer "unnecessary" movements that could otherwise interfere with their playing. Professional players, meanwhile, moved less smoothly and with a higher acceleration than the amateurs. This seemed to be related to a more distinct gestural projection of the musical structure (e.g., Vines et al., 2004), which in turn seems to be related to the intention of bringing the musical meaning across to an audience – a skill that most likely develops with increasing expertise and performance experience.

Although some limitations of the study should be acknowledged - such as the small sample size, the limited differentiation between amateurs and professionals, and the non-randomization of playing conditions to ensure that the Technical and Expressive condition were not affected by the mood induction task - the findings are important in several regards. First, the use of motion-capture technology to study the effect of felt emotion on musical performance seems promising. In future studies, the analyses might be extended by looking at time series of movement data rather than at mean data, and by investigating aspects such as movement per bar or musical unit. Changes in angles of body and instrument segments such as the hips, the shoulders, the head, and the violin and bow, might be interesting to investigate as well. Second, the findings seem to offer concrete evidence for the difference between emotional and expressive playing suggested by Van Zijl and Sloboda (2011). It is important to note, however, that only performances of a sad phrase were investigated. In the case of an emotion such as anger, the results may be different. Future research should examine this issue. Third, in addition to their value for music research, the findings are interesting concerning the debate about whether felt and portrayed emotions result in similar vocal, facial, or bodily expressions (e.g., Bachorowski & Owren, 2003; Crane & Gross, 2007; Banse & Scherer, 1996; Wallbott, 1998; Zuckerman et al., 1976). The present findings suggest that felt and expressed emotions in music result in different expressions. Future research should address the perceptibility of such differences by an audience, the interaction between movement and audio features, and, ultimately, what type of performance or expression an audience prefers.

Study III investigates the effect of performers' experienced emotions on auditory performance features, and draws some links with the movement characteristics revealed in Study II. Study IV investigates the audience perception of the performances analysed in Studies II and III.

6.3 Study III: Auditory Performance Characteristics

6.3.1 Aim

Study III aimed to investigate the effect of performers' experienced emotions on auditory performance characteristics. To this end, performers were asked to play a musical phrase in response to three different instructions – focus on technique; focus on expressivity; focus on experienced emotions. For the performances obtained, the tempo, articulation, dynamics, timbre, and vibrato were investigated.

6.3.2 Methods

Studies II and III are based on the same data collection procedure. Hence, for a description of the participants, musical stimuli, apparatus, and materials and procedure, see section 6.2.2.

Audio feature extraction
Using the MATLAB MIR Toolbox (Lartillot & Toiviainen, 2007), several audio features were extracted for (each bar of) each performance. To investigate the tempo of the performances, the performance duration in seconds, the duration of each bar in seconds, and the coefficient of variation of the bar durations were examined. Articulation was investigated by estimating the attack slope of each note. To investigate the dynamics of the performances, the root mean square energy (RMS), both per performance and per bar, as well as the difference between the minimum and maximum RMS values of the bars of each performance were calculated. Timbre was investigated by extracting two features: The spectral centroid, a measure indicative of the centre of mass of the spectrum, and connected to the perception of brightness of a sound (Grey & Gordon, 1978); and roughness, a measure indicative of sensory dissonance related to the beating phenomenon whenever pairs of sinusoids are close in frequency (Plomp & Levelt, 1965). The relative vibrato depth was determined as the standard deviation of pitch estimates for successive windows divided by the fundamental frequency, while the vibrato rate was estimated by applying autocorrelation to the time series of estimated fundamental frequencies, and determining the lag that yields the first maximum in the autocorrelation. To account for differences caused by recording settings, distance to the microphone, or instrument characteristics, the RMS, spectral centroid, and roughness values were normalised to a mean of unity across performances for each participant.

Analyses
Differences in tempo, articulation, and vibrato were analysed via mixed-design ANOVAs with performance condition and bar number or note number as within-subjects factors, expertise (amateur or professional) as between-subjects factor, and post-hoc pair-wise comparisons with Bonferroni correction for multiple comparisons. Differences in dynamics and timbre were analysed via

repeated-measures ANOVAs with performance condition and bar number as within-subjects factors, and post-hoc pair-wise comparisons with Bonferroni correction for multiple comparisons. In the case of the dynamics and timbre analyses, differences between amateurs and professionals were analysed via independent t-tests on the non-normalised data.

6.3.3 Results

Tempo
The main effect of performance condition on performance duration was significant, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Emotional and between the Expressive and Emotional performances only. The performances of the professionals were significantly shorter than the performances of the amateurs. The main effect of performance condition on tempo fluctuation was non-significant. The tempo of the amateurs fluctuated significantly more than the tempo of the professionals.

Articulation
The main effect of performance condition on attack slope was significant, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive and between the Expressive and Emotional performances only. The performances of the professionals were associated with a significantly higher attack slope value than the performances of the amateurs.

Dynamics
The main effect of performance condition on normalised mean RMS was significant, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive and Expressive and Emotional performances only. The main effect of performance condition on dynamic range was significant, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive and Expressive and Emotional performances only. The dynamic range used by the professionals was significantly larger than the dynamic range used by the amateurs.

Timbre
The main effect of performance condition on normalised mean spectral centroid was non-significant. No significant difference was found in spectral-centroid values between the performances of the amateurs and professionals. The main effect of performance condition on normalised roughness was significant, although the differences between specific performance conditions did not reach significance in the post-hoc pair-wise comparisons. The performances of the professionals were associated with a significantly higher roughness value than the performances of the amateurs.

Vibrato
The main effect of performance condition on the relative vibrato depth was significant, with post-hoc pair-wise comparisons indicating significant differences

between the Technical and Expressive and Expressive and Emotional performances only. The amateurs used a slightly wider vibrato than the professionals. The difference, however, was not statistically significant. The main effect of performance condition on vibrato rate was significant, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive and Expressive and Emotional performances only. The vibrato of the professionals was significantly faster than the vibrato of the amateurs.

6.3.4 Discussion

Study III aimed to investigate the effect of performers' experienced emotions on auditory performance characteristics. To this end, performers were asked to play a musical phrase in response to three different instructions. The tempo, articulation, dynamics, timbre, and vibrato of the performances obtained were analysed. It was found that the emotions experienced by performers affected the auditory characteristics of their performances. Each performance condition revealed a different pattern of auditory characteristics.

The auditory characteristics of the Technical performances often resembled the characteristics of one of the other conditions. In the case of tempo (i.e., average performance duration), the Technical performances were played almost as fast as the Expressive performances. In the case of articulation (i.e., attack slope), dynamics (i.e., mean RMS), and timbre (i.e., mean roughness), the Technical performances resembled the Expressive performances during the first eight bars of the phrase, and the Emotional performances during the last six bars. The dynamic range (i.e., the difference between the minimum and maximum RMS) was smallest in the Technical performances, whereas the relative vibrato depth was average and the vibrato rate lowest as compared to the other conditions.

The Expressive performances were generally characterised by the highest values of the auditory characteristics investigated. As compared to the Emotional performances in particular, the Expressive performances were characterised by a faster tempo, a louder sound, the largest dynamic range, a rougher timbre, rapid note attacks, and a relatively wide and fast vibrato.

The Emotional performances were generally characterised by the lowest values of the auditory characteristics investigated. The Emotional performances were played more slowly, with a less rough timbre, and less rapid note attacks, as compared to the Technical and Expressive performances. As regards dynamics and vibrato, the Emotional performances were played more softly, with a smaller dynamic range, and a narrower and slower vibrato than the Expressive performances, but with a larger dynamic range and slightly faster vibrato than the Technical performances.

The patterns of auditory performance characteristics seemed to indicate that a focus on technique or felt emotions resulted in more introverted playing, whereas a focus on expressivity resulted in more extraverted playing. This interpretation was supported by the interview data.

Differences were also found between the performances of the amateur and professional performers. The amateurs played slower, softer, with less rapid

note attacks, a less rough timbre, and a wider and slower vibrato, as compared to the professionals. These differences in auditory performance characteristics might be explained by differences in level of expertise. The amateurs might have chosen to play the phrase at a slower tempo to make sure they could cope with the technical demands of the phrase. The vibrato might have been adjusted to the slower playing tempo. The softer dynamics, differences in timbre, and less rapid note attacks might have been related to the bowing technique used. The bow speed, bow-pressure, and distance from the bridge, for instance, affect the intensity and timbre of the sound. A higher bow speed (while keeping the bow-pressure and distance constant) results in a more intense sound, but requires a higher level of expertise (Gelre, 1991). The shaping of the individual notes, likewise, is related to bow control, something that increases when expertise develops.

The auditory characteristics revealed in Study III and movement characteristics revealed in Study II are related in a meaningful way. As indicated above, it is likely that dynamics, articulation, and differences in timbre are related to the bowing technique used. The finding that performers' bow speed and acceleration were highest in the Expressive performances and lowest in the Emotional performances supports this explanation.

In addition, the findings are consistent with the preliminary findings by Higuchi et al. (2010) and Glowinsky et al. (2008): Performers played with less rapid note attacks in the Emotional performances, and differences were found in the duration of the performances in different conditions. It is important to note, however, that only the performances of the sad phrase were analysed. In the case of sadness, performers displayed more extraverted playing when expressing the music, and more introverted playing while feeling the music – but different results may well be found in the case of emotions such as happiness or anger.

When comparing the findings of the present study to the acoustic characteristics generally associated with the musical expression of sadness (Juslin, 2009), there are many similarities. When comparing the Technical, Expressive, and Emotional performances, the auditory characteristics of the Emotional performances seem to be most representative of the features associated with the expression of sadness, such as a slow tempo, low sound level, dull timbre, slow note attacks, and a slow and narrow vibrato. In this regard, these findings contrast with some of the findings by Erickson et al. (2006) regarding the vocal expression of emotions. Erickson et al. found that imitated sad speech more strongly followed existing stereotypes of what constitutes sad speech, and that imitated sad speech received higher ratings of sadness than spontaneous sad speech. That the present study did not find the Expressive performances to be most representative of features associated with sadness might be due to the focus on technical, expressive, and emotional performance instructions, rather than asking performers to communicate distinct emotions. In the case of the present data, it is likely that listeners would rate the Emotional performances as most representative of sadness – which is indeed what was found in Study IV.

Although some limitations of the study should be acknowledged - such as the small sample size, the limited differentiation between amateurs and profes-

sionals, and the non-randomization of playing conditions to ensure that the Technical and Expressive condition were not affected by the mood induction task - the findings are important in several regards. First, they show that a different performance focus results in differences in auditory features. Of particular interest is the finding that a focus on expressivity resulted in more extraverted playing, whereas a focus on felt emotions resulted in more introverted playing. It would be worth exploring whether this finding is bound to the expression of sadness, or whether it holds for other emotions as well. As such, this finding seems to be important in the context of music education and performance, and might be valuable with regard to music therapy as well. Second, the findings are of interest for the debate about whether felt and portrayed emotions result in similar vocal, facial, or bodily expressions (e.g., Bachorowski & Owren, 2003; Crane & Gross, 2007; Banse & Scherer, 1996; Wallbott, 1998; Zuckerman et al., 1976). The present results suggest that felt and expressed emotions in music result in different expressions. It is important to note, however, that it is not clear whether musicians actually aim to express discrete emotions when performing. Future research should investigate the performer's perspective in more detail. Future work should also examine the effect of a performer's focus on performance features in a real concert setting, as well as the effect of a performer's focus on audience perception.

Study IV looks into the effect of a performer's focus on audience perception, while Study V investigates the performer's perspective in more detail.

6.4 Study IV: Audience Perception of Performances

6.4.1 Aim

Study IV aimed to investigate the effect of performers' experienced emotions on audience perception of performances. To this end, participants rated performances given in response to different instructions in terms of preference, perceived skill of the performer, and perceived emotional expression.

6.4.2 Methods

Participants
Thirty students participated in the study. All participants had played a musical instrument (including voice) for at least one year, while the majority had played a musical instrument (including voice) for more than ten years.

Stimuli
The stimuli consisted of a selection of performances recorded for and analysed in Studies II and III. The performances of four violinists (two amateurs and two professionals) who were asked to play the same musical phrase in response to three different performance instructions were included. As stated before, the first instruction was to focus on the technical aspects of their playing (i.e., the

Technical performances). The second instruction was to give an expressive performance (i.e., the Expressive performances). Following a sadness-inducing mood induction task, the third instruction was to play while focusing on their felt emotions (i.e., the Emotional performances). High quality audio and motion-capture recordings were made of all performances. The selected performances were the ones that the performers themselves indicated to be "most representative for the performance instruction given".

For Study IV, motion-capture animations were created using the MATLAB Motion Capture Toolbox (Toiviainen & Burger, 2010). Using QuickTime 7 software, the motion-capture animations were paired with the audio recordings. A presentation film depicting the motion-capture animations, audio recordings, and motion-capture animations with audio recordings, was created using iMovie software. The order of the performances was randomised within each presentation mode.

Procedure

The performances were presented on a big screen in an auditorium. Participants were asked to rate their agreement with the statements (1) I like this performance, (2) The performer is skilled, and (3) This performance is expressive of sadness, on a seven-point bipolar scale (completely disagree – completely agree).

The performances were presented in three blocks. In the first block, the motion-capture animations were shown without sound (i.e., Vision-only). In the second block, only the audio recordings were played (i.e., Audio-only). In the third block, the motion-capture animations were shown with sound (i.e., Vision & Audio). After each performance, participants had 20 seconds to rate the performance, until a sound signal indicated the start of the next performance.

To make sure that all participants understood the rating procedure, data collection was preceded by a practice trial. After rating all performances, participants were asked to write down any comments they had about the study and their experiences. Data collection lasted approximately 45 minutes.

Analyses

Participants' ratings were analysed by means of three (one for each statement) three-way repeated-measures ANOVAs with presentation mode (Vision-only, Audio-only, Vision & Audio), expertise of the performer (Amateur, Professional), and performance condition (Technical, Expressive, Emotional) as independent variables, and post-hoc pair-wise comparisons with Bonferroni correction for multiple comparisons. Correlations between the ratings of the three statements were analysed by means of Pearson's Correlation Coefficient.

6.4.3 Results

Preference
The main effect of performance condition on preference ratings was significant, with Bonferroni corrected post-hoc pair-wise comparisons revealing significant differences between the Technical and Expressive, and between the Expressive and Emotional performances only. The Expressive performances received the highest preference ratings overall. The main effect of performer's expertise on preference ratings was significant, with the performances of the Professionals receiving the highest ratings overall. The Vision-only performances received the highest preference ratings overall, although the main effect of presentation mode on preference ratings was non-significant.

Significant interactions were found between mode and expertise, between mode and performance condition, and between mode, expertise, and performance condition. The interaction between expertise and performance condition was non-significant.

Perceived expertise
The main effect of performance condition on expertise ratings was significant, with Bonferroni corrected post-hoc pair-wise comparisons revealing significant differences between the Technical and Expressive, and between the Expressive and Emotional performances only. The Expressive performances received the highest ratings of perceived expertise overall. The main effect of performer's expertise on perceived expertise ratings was significant, with the performances of the Professionals receiving the highest ratings overall. The Vision & Audio performances received slightly lower ratings of perceived expertise, although the main effect of presentation mode on expertise ratings was non-significant.

Significant interactions were found between mode and expertise, between mode and performance condition, between expertise and performance condition, and between mode, expertise, and performance condition.

Perceived emotional expression
The main effect of performance condition on ratings of perceived expression of sadness was significant, with Bonferroni corrected post-hoc pair-wise comparisons revealing significant differences between the Technical and Emotional, and between the Expressive and Emotional performances only. The Emotional performances received the highest ratings of perceived expression of sadness overall. The main effect of performer's expertise on perceived expression of sadness ratings was significant, with the performances of the Amateurs receiving the highest ratings overall. The main effect of presentation mode on perceived expression of sadness ratings was significant, with Bonferroni corrected post-hoc pair-wise comparisons revealing significant differences between the Vision-only and Audio-only, and between the Vision-only and Vision & Audio presentation modes only. The performances in the Vision-only mode received lower ratings of perceived expression of sadness than the performances in the Audio-only and Vision & Audio modes.

A significant interaction was found between mode and performance condition. The interactions between mode and expertise, between expertise and performance condition, and between mode, expertise, and performance condition, were non-significant.

Correlations
A significant correlation was found between ratings of preference and perceived expertise. No correlation was found between ratings of preference and perceived emotional expression, or between ratings of perceived expertise and perceived emotional expression.

6.4.4 Discussion

Study IV aimed to investigate the effect of performers' experienced emotions on audience perception. To this end, audience members were asked to rate 36 performances. For each performance, audience members rated whether they liked the performance, whether they thought the performer was skilled, and whether they perceived the performance as being expressive of sadness.

Statistical analyses of audience ratings revealed that, overall, audience members preferred the Expressive performances to the Technical and Emotional ones. In addition, the Expressive performances were rated as played by the most skilled performers. The Emotional performances, however, were rated as being most expressive of sadness. As revealed in Study II, in the Expressive performances, the performers moved most, fastest, with most acceleration, and lowest levels of smoothness, as compared to the Technical and Emotional ones. As revealed in Study III, the Expressive performances were characterised by the fastest tempo, the loudest sound, the roughest timbre, rapid note attacks, and a wide and fast vibrato, as compared to the Technical and Emotional ones. The finding that audience members preferred the Expressive performances and believed they were played by the most skilled performers but perceived the Emotional performances to be most expressive of sadness might suggest that a more external focus on the part of the performer (i.e., "give an expressive performance") results in an extraverted and "better" performance, whereas a more internal focus (i.e., "focus on felt emotions") results in an introverted and "emotional" performance.

When looking at differences between the Amateur and Professional performers, overall, the performances of the Professional violinists were rated higher in terms of preference and perceived skill. The Amateur performances, however, were perceived as being more expressive of sadness. Analyses of performers' movements (Study II) revealed that the Amateurs moved more, more slowly, more smoothly, and with less acceleration than the professionals. Analyses of audio features (Study III) revealed that the Amateurs played slower, softer, with less rapid note attacks, a different timbre, and a wider and slower vibrato, as compared to the Professionals. It seems that both the movement and auditory characteristics of the Amateur performances were more in line with the characteristics generally associated with the expression of sadness (e.g., Crane & Gross, 2007; Juslin & Laukka, 2003).

The presentation mode, overall, did not influence the ratings for preference and perceived expertise. The presentation mode, however, did affect the ratings for perceived emotional expression. The ratings for perceived expression of sadness were much lower in the Vision-only condition. This might be explained by the presentation order of the stimuli: When rating the performances in the Vision-only condition, the audience members did not know the piece that was played – although they had heard it in the practice trial. It may be difficult to infer the emotional expression of a performance by looking at motion-capture animations without the accompanying sound.

The findings suggest that a performer's experienced emotions affect the perception of the performance by an audience. It was found that audience members perceived the Emotional performances as being more expressive of sadness than the Technical and Expressive ones. It seems that sad feelings on the part of the performer can make a sad piece of music sound sadder. Future research should examine the effect of emotions other than sadness. The audience members in the present study preferred the Expressive performances and perceived them as being played by the most skilled performers. As such, these findings are valuable for music education, research, and performance. Future research should examine the effect of a performer's experienced emotions on performance features and audience perception in a live concert setting. Study V can be seen as a first exploration of performers' experienced emotions in a live concert setting, focusing on the conceptualisation of "emotional" and "expressive" playing.

6.5 Study V: Performers' Emotions in Performance

6.5.1 Aim

Study V aimed to investigate what role performers' experienced emotions play in performance. An additional aim was to explicate the meaning of emotional and expressive playing in music performance. To this end, participants completed an in-depth interview in which they reflected on a recent performance experience.

6.5.2 Method

Participants
Nineteen musicians, teaching or studying at a conservatoire, participated in the study. All of them were classically trained musicians. The sample contained string, keyboard, woodwind, brass, and percussion players.

Procedure
The in-depth, semi-structured interviews consisted of four parts. In the first part, the structure of the interview was explained, participants were asked to sign a consent form, and given the opportunity to ask any questions. In the sec-

ond part, participants were asked to think of a recent performance experience. They were encouraged to describe this experience in as much detail as possible, and describe what they experienced before the performance, when going on-stage, when starting to play, while playing, when ending the performance, and after the performance. In the third part, participants were asked to make a visual representation (with pencil on paper) of their experiences on stage. In the fourth part, participants were asked to answer some general, reflective questions: How they would describe their ideal performance, how they would describe emotional and expressive playing, whether emotions help them or whether they hinder them, to what extent they think emotions are necessary for a successful performance, if they could think of any aspect related to emotions not discussed yet, and whether they had anything to add or ask. The interviews lasted approximately 60 minutes (range: 50 – 90 minutes). All interviews were recorded and transcribed verbatim.

Analysis
The interviews were analysed by means of qualitative thematic analysis. This involves an interpretative analysis of textual meaning based on a coding scheme derived both deductively from pre-existing concerns, questions and hypotheses, and inductively from examination of the actual data (Seale, 2004).

6.5.3 Results

Analysis of the interviews allowed a detailed characterisation of the role of performers' emotions on stage. A distinction was revealed between performance-related emotions and emotions related to the music. In addition, it was found that emotional and expressive playing were perceived in different ways.

Performance-related emotions
Performance-related emotions as described by the musicians were emotions such as excitement or anxiety, and they were typically characterised by an urge to move or play faster, and bodily sensations such as sweaty hands, muscle tension, or trembling.

Music-related emotions
In addition to emotions related to the act of performing in front of an audience, performers tend to experience emotions in relation to the music they perform. The score played a central role in the accounts of the musicians interviewed. A score, however, needs to be interpreted. As revealed in Study I, the process of interpreting the score mainly takes place in the practice room, where musicians translate the notes into a musical narrative and try to find and master the technical means to manifest the narrative on their instruments. In order to bring the musical narrative to life, on stage, the musicians in the present study tended to connect emotionally with the musical narrative by relying on life experiences, and connecting to the reasons why they are musicians: Their love for music, the desire to share their music with others, and the belief that music has some deeper meaning which needs to be understood and communicated.

When connecting emotionally with the musical narrative, all participants emphasised the importance of maintaining a balance between being emotionally involved (in the way in which a listener might be) and being in control of their playing. In addition, all musicians emphasised the need to have the technical ability to express the musical narrative on their instrument. The balance between being emotionally involved and being in control of their playing is reflected in the performers' perspectives on emotional and expressive playing.

Emotional playing
In the interviews, all musicians described the difference between emotional and expressive playing in a similar way. Emotional playing was associated with genuine playing, with experiencing raw emotions, and with directly feeling the emotional impact of the music. In addition, emotional playing was associated with the risk of getting carried away, and losing control of performance. All musicians agreed that experiencing emotions while playing was important for their motivation to practise and perform. However, most musicians indicated that it is not helpful to experience strong emotions on stage.

Expressive playing
Expressive playing was associated with playing what the score prescribes, with bringing out the structure of the music, and having the technical ability to express the composer's intentions. Although several musicians believed that one could give a successful performance without being emotionally involved, it was suggested that being emotionally connected with the musical narrative might turn a technically perfect performance into a remarkable one. On stage, the interviewed musicians all aimed for expressive playing rather than emotional playing. They seemed to identify with and feel the musical emotions to some extent, while ensuring that they had the technical ability to express the musical emotions on their instrument, and remaining in control of their playing.

6.5.4 Discussion

Study V aimed to investigate what role performers' experienced emotions play on stage, by asking performers to reflect on a recent performance experience. A difference was found between performance-related emotions and emotions related to the music. As regards the music-related emotions, a complex relationship was found between the music and the performer (which will be presented in more detail in future publications). An additional aim was to explicate the meaning of emotional and expressive playing in music performance: Emotional playing was associated with genuine playing, with experiencing raw emotions, and with directly feeling the emotional impact of the music. It was also associated with the risk of getting carried away, and losing control of performance. Expressive playing, on the other hand, was associated with playing what the score prescribes, with bringing out the structure of the music, and having the technical ability to express the composer's intentions.

In light of these results, the finding by Lindström et al. (2003) that music students defined "playing expressively" either in terms of "playing with feeling"

(focus on the performer's own feelings) or in terms of "communicating emotions" (focus on conveying something to the audience) might suggest that the role of performers' experienced emotions in expressive performance is something musicians discover at some point during their education, and that musicians have to make the transition from approaching musical emotions as a listener to approaching musical emotions as a performer.

Although it is possible to experience strong emotions while playing, performers are likely to make mistakes and lose control of their playing when getting carried away too much. In addition, just feeling something does not necessarily mean that that feeling is transmitted to an audience. All musicians interviewed emphasised the need to translate the notes into expressive music by finding and mastering the appropriate technical means before going on stage. The performers in the present study aimed for expressive playing rather than emotional playing. They intended to feel the musical emotions to some extent, while ensuring that they had the technical ability to express them on their instrument, and remaining in control of their playing. These findings support the validity of distinguishing between emotional and expressive playing, and could be relevant to both research and artistic practice and pedagogy.

7 DISCUSSION

The aim of the research presented in this thesis was to investigate the role of performers' experienced emotions in the practice and performance process of an expressive performance, as well as the effect of performers' experienced emotions on performers' movement characteristics, auditory performance characteristics, and audience perception of performances. In this Chapter the main findings, limitations, and implications of the research are discussed.

7.1 Performers' Emotions in Expressive Performance

The first research question – What is the role of performers' experienced emotions in the practice and performance process of an expressive performance? – was investigated in Studies I and V. Using predominantly qualitative research methods, these studies provided an in-depth insight into the performers' perspective on experienced emotions.

Study I revealed that performers' emotions involved in the practice process consist of both perceived and felt emotions, the latter further subdivided into music-related and practice-related emotions. Importantly, the prevalence of performers' experienced emotions was found to change over the duration of the practice process. Four phases were identified in the construction process of an expressive performance. In Phase 1, the initial exploration of the piece, performers explored the piece in a technical and emotional way by playing it through, while focusing on perceived and felt music-related emotions. In Phase 2, the mastering of technical difficulties, performers focused on practising shorter sections of the music, while felt emotions related to the practice activity prevailed. In Phase 3, the construction of an expressive interpretation, performers at first tried to bring their felt emotions in line with the emotions perceived in the music, by applying different "inner techniques". As the learning process developed, the performers found appropriate technical means to translate their feelings into expressive music. Interestingly, once the performers had figured out these technical means, their music-related felt emotions waned. "Feeling"

the musical emotions transformed into "knowing what to do" in order to convey them. In Phase 4, the construction of an expressive performance, performers allowed themselves to feel some music-related emotions again, while largely adhering to the previously constructed interpretation detailing the skills and knowledge of appropriate musical features, and while being aware of the act of performing.

Study V revealed that performers' emotions involved in the performance process consist of both performance-related and music-related emotions, the latter detailing a complex relationship between the performer and the music. Emotional and expressive playing were conceptualised differently. Emotional playing was associated with genuine playing, experiencing raw emotions, and directly feeling the emotional impact of the music. In addition, emotional playing was associated with the risk of getting carried away, and losing control of performance. Expressive playing was associated with playing what the score prescribes, bringing out the structure of the music, and having the technical ability to express the composer's intentions. On stage, the interviewed musicians all aimed for expressive playing rather than emotional playing. They seemed to identify with and feel the musical emotions to some extent, while ensuring that they had the technical ability to express the musical emotions on their instrument, and while remaining in control of their playing.

Studies I and V revealed that performers' experienced emotions play an important role in the process of constructing and delivering an expressive performance. As such, the results support the findings by Persson (1993; 2001) and Lindström et al. (2003), suggesting that a performer should experience certain emotions in order to be able to perform in an expressive way. Like the musicians in Persson's study (1993), for instance, the performers interviewed in Studies I and V made use of techniques to feel the music-related emotions. In addition, it could be said that during the initial exploration of the piece the performers created a kind of framework that directed how the music should be played (noodynamic reference). This framework was based on how the performers "felt the music should sound" (hedonic emotional reference) and on the structure of the music and conventions regarding the musical style (music structural reference). When the performers' feelings were not in line with the prescriptions in and conventions regarding the score of the music (conflict component), the performers compromised how they felt about the music. As such, the findings confirm the factors that influence the generation of musical performance as proposed by Persson (1993). Moreover, although performers' experienced emotions have been addressed in previous studies (e.g., Kenny, 2010; Lamont, 2012), the findings of Studies I and V provide a more comprehensive view of the different types of emotions (i.e., perceived and felt, practice-related, performance-related, and music-related emotions) performers experience in practice and performance.

Studies I and V also revealed that musicians apply appropriate technical means, follow conventions regarding musical structure and style, and construct their expressive interpretation before the actual performance takes place. As such, the results support the findings by Sloboda and Lehmann (2001) and Chaffin et al. (2002; 2006), suggesting that an expressive performance is a matter

of deliberate conscious awareness and planned expressiveness. The four phases in the construction process of an expressive performance, for instance, can be compared to the stages in the process of learning to play a piece from memory as identified by Chaffin et al. (2002): The initial exploration of the piece (Phase 1) can be compared to the stage of "scouting it out"; the mastering of technical difficulties (Phase 2) to the stage of "section by section"; the construction of an expressive interpretation (Phase 3) incorporates aspects Chaffin et al. describe in the "gray stage" and "putting it together" stage; and the construction of an expressive performance (Phase 4) can be compared to the stage of "polishing". As such, the findings confirm the different stages as identified by Chaffin et al. (2002). Moreover, the findings encompass the role a performer's experienced emotions play in the process of constructing an expressive performance. The findings suggest that performers' experienced music-related emotions play a role especially regarding the decisions made in relation to "interpretative cues" and "expressive cues" as identified by Chaffin et al. (2002; 2006).

The findings of Studies I and V suggest that performers, in the words of Gabrielsson (2001-2002), "strive for emotional identification but still have some conscious control of performance" (p. 138). To better understand this, it seems to be helpful to distinguish between different ways of playing, such as "emotional" and "expressive" playing (Van Zijl & Sloboda, 2011). The performers in Study I described emotional playing as "just feeling and enjoying the music". The performers in Study V elaborated on this by associating emotional playing with genuine playing, with directly feeling the emotional impact of the music, and with running the risk of losing control of performance. According to the performers in Study I, in expressive playing, conveying the previously constructed interpretation to an audience takes centre stage. The performers in Study V elaborated on this by associating expressive playing with playing what the score prescribes, and having the technical ability to express the composer's intentions. In expressive playing, performers try to be engaged with the music-related emotions, while they make sure to be in control of their playing. As stated before, in music and emotion research so far no distinction has been made between genuinely felt and portrayed expression of emotions through music (Juslin, 2009). The findings of Studies I and V, however, indicate that such a distinction is important for performing musicians and their understanding of how to best achieve an expressive performance.

7.2 Sound, Movement, and Perception

The second research question – What is the effect of performers' experienced emotions on performers' movement characteristics, auditory performance characteristics, and audience perception of performances? – was investigated in Studies II, III, and IV. Using predominantly quantitative research methods, these studies provided concrete evidence that performers' experienced emotions affect the sound, movement, and perception of their performances.

Study II revealed that a focus on technique, expressivity, or felt emotions results in different movement characteristics of performers. When focusing on technique, the performers moved least, with medium speed, medium acceleration, and medium smoothness. When focusing on expressivity, the performers moved most, fastest, with most acceleration, and lowest levels of smoothness. When focusing on felt emotion, the performers moved with a moderate amount of movement, lowest speed, lowest acceleration, and highest levels of smoothness. The patterns of movement characteristics indicated that a focus on technique or felt emotions resulted in more introverted playing, whereas a focus on expressivity resulted in more extraverted playing.

Study III revealed that a focus on technique, expressivity, or felt emotions results in different auditory performance characteristics. When focusing on technique, the performers played moderately fast, with moderately rapid note attacks, moderate dynamics, the smallest dynamic range, a moderately rough timbre, and a vibrato characterised by a moderate width and low rate. When focusing on expressivity, the performers played fastest, with the most rapid note attacks, loudest, with the largest dynamic range, the most rough timbre, and a wide and fast vibrato. When focusing on felt emotions, the performers played slowest, with the least rapid note attacks, softest, with a moderate dynamic range, the least rough timbre, and a moderately fast and wide vibrato. The patterns of auditory performance characteristics indicated that a focus on technique or felt emotions resulted in more introverted playing, whereas a focus on expressivity resulted in more extraverted playing.

Study IV revealed that audience members perceived performances played with a focus on technique, expressivity, or felt emotion differently. The technical performances received the lowest ratings in terms of preference and perceived emotional expression, and average ratings in terms of perceived skill of the performer. The expressive performances received the highest ratings in terms of preference and perceived skill of the performer, and average ratings in terms of perceived emotional expression. The emotional performances were rated average in terms of preference, lowest in terms of perceived skill of the performer, and highest in terms of perceived emotional expression. The findings indicate that a focus on expressivity results in a performance the audience prefers, whereas a focus on felt emotions results in a performance perceived as being most expressive of emotion.

Studies II, III, and IV revealed that performers' experienced emotions affect the sound, movement, and perception of their performances. As regards performers' movements, Study II seems to be the first study examining the effect of performers' experienced emotions on body posture and movement characteristics. Movement analyses with the MoCap toolbox (Toiviainen & Burger, 2010) proved to be effective in revealing subtle differences between a large number of performances. The movement characteristics generally associated with the expression of sadness (Wallbott, 1998; Crane & Gross, 2007) were exhibited most strongly when performers focused on felt emotions. The findings of Study II indicate that a focus on expressivity or felt emotions results in different bodily expressions - which is of interest in light of the debate as to whether felt and portrayed expressions of emotions result in similar bodily ex-

pressions (e.g., Wallbott, 1998), as well as in light of research in sports psychology investigating the effect of performers' focus on motor skills (e.g., Wulf, 2013).

As regards the auditory performance characteristics, Study III improved the research design and confirmed and extended the findings of Higuchi et al. (2010) and Glowinski et al. (2008). Audio analyses with the MIR toolbox (Lartillot & Toiviainen, 2007) proved to be effective in revealing subtle differences between a large number of performances. The audio features generally associated with the expression of sadness (Juslin, 2009) were exhibited most strongly when performers focused on felt emotions. The findings of Study III indicate that a focus on expressivity or felt emotions results in different sound expressions – which is of interest in light of the debate as to whether felt and portrayed expressions of emotions result in similar expressions (e.g., Banse & Scherer, 1996).

As regards audience perception, Study IV seems to be the first study investigating the effect of performers' experienced emotions on audience perception. The findings reveal that even motion-capture animations (i.e., stick-figures) of performing musicians playing the same musical phrase while focusing on technique, expressivity, or felt emotions convey sufficient information to influence audience ratings of performances. Of interest is that the findings of Study IV – as well as the findings of Studies II and III – indicate that the performances of the amateur performers were perceived as being more expressive of sadness than the performances of the professional performers. This finding might suggest that less experienced performers are more strongly affected by their emotions when performing than professional performers – perhaps because professional performers have learned to play expressively rather than emotionally.

7.3 Limitations

Some limitations of the thesis should be acknowledged. First, the performer, the performance, and the audience have been investigated separately. The advantage of investigating the performers' perspective, performance characteristics, and audience perception in different settings was that the setting and research methods could be tailored to the research questions. This resulted in a large amount of different and detailed data. A disadvantage of this approach, however, was that the performances investigated in Studies II, III and IV were not necessarily comparable to the performances reported in the Diaries and interviews of Studies I and V. In addition, the mediated form (i.e., as audio recordings and motion-capture animations) in which the performances investigated in Studies II and III were presented to audience members in Study IV may have influenced the perceptual judgements in a way that differs from a traditional concert setting. Future research should investigate the process of preparing and performing a piece of music by following the same performers and recording and rating them in a live concert setting.

Second, in Studies II, III and IV, the only emotion investigated was sadness. As a result, the finding that performers' playing tends to be of a more

introverted character when focusing on felt emotions as compared to when focusing on expressivity is limited to the emotion of sadness. In the case of emotions such as happiness or anger one may well find different results. In the case of happiness, for instance, one may find that performers' playing tends to be of a more extraverted character when focusing on felt emotions as compared to when focusing on expressivity – following the line of thought that the behaviour associated with the expression of a certain emotion gets intensified when focusing on felt emotions. Likewise, a focus on felt anger may result in uncontrolled performances – which would support the findings of Study V stating that emotional playing implies the risk to lose control of one's playing. Future research should test this by investigating emotions other than sadness.

Third, Studies II, III and IV focused on performances of female string players. Although a pilot study with a male bassoon player showed similar results, future research should test the generality of the findings by investigating a larger sample and instrumentalists other than female string players. In addition, it would be of interest to examine the performances of singers, and investigate the influence of lyrics on experienced emotions and performance characteristics.

Fourth, all the musicians who participated in the studies were classically trained. Hence, the findings are limited to a classical music setting. It would be of interest to investigate whether the findings are applicable to other genres. Apparent differences between genres are, for instance, the central position or absence of a score, the aim to play exactly as written or to improvise, the praxis to perform someone else's compositions or to perform one's own work, and the relative importance attributed to technical perfection. As a result, the role of performers' experienced emotions is likely to be different across genres. However, ultimately, performers of different genres may have the same goal: To move their audiences. To this end, an appropriate balance between feeling the music-related emotions and being in control of one's playing will be required – which may suggest that performers across genres face similar issues when it comes to the preparation and delivery of a performance. Future research should test this, by investigating the practice and performance process and resulting performances of performers other than classical musicians.

Finally, each investigation entailed certain choices in terms of research design, methods employed, and techniques of analyses applied. In Study I, for instance, one could have made video recordings of performers' practice sessions instead of asking them to keep a Diary. A Diary, however, seemed to provide direct access to the inner experiences of the performer, whereas video recordings would not have revealed directly the thoughts and feelings of the performer. In Studies II and III, physiological measurements of heart rate, galvanic skin conductance, electromyography, or perhaps salivary cortisol could have provided additional information on the effectiveness of the mood-induction procedure or on the characteristics of the different performances. The problem with such measurements, however, is that it is difficult to tell whether physiological changes are due to the environment, the act of playing an instrument, the mood-induction procedure, or other reasons. In addition, physiological measurements can be experienced as quite intrusive, which would have af-

fected the ecological validity of the research set-up. In Study IV, instead of collecting ratings on a seven-point bipolar scale completed after listening to or watching a performance, it could have been possible to use continuous response measurements to collect audience ratings. Although this could have been arranged when collecting the ratings of each audience member individually, this was not possible in a research setting imitating a concert experience. In Study V, finally, one could have made video recordings of performances that were then watched back and discussed with the performers. However, the performers interviewed reported on concerts given at venues around the world. Making video recordings of the performances discussed would have been impossible. Future research, however, might test such alternative approaches – and shed light on the validity of the present findings.

7.4 Implications

The research presented in this thesis has theoretical implications for the field of music psychology as well as practical implications for the practice and pedagogy of music performance.

First, this thesis shows that performers' experienced emotions play a role in the construction and delivery of an expressive performance. Compared to the literature published hitherto, this thesis provides a more comprehensive view of the different types of emotions (i.e., perceived and felt, practice-related, performance-related, and music-related emotions) performers experience in practice and performance. Future research should investigate these different types of emotions and how they interact in more detail in order to gain a deeper insight into music performance as a creative practice.

Second, this thesis proposes a theoretical distinction between emotional and expressive playing. It shows that for performing musicians these are different concepts. The performing musicians interviewed for this thesis aimed for expressive playing rather than for emotional playing. In an attempt to explain the finding by Lindström et al. (2003) that music students defined "playing expressively" either in terms of "communicating emotions" (focus on conveying something to the audience) or in terms of "playing with feeling" (focus on the performer's own feelings), this thesis hypothesizes that the role of performers' experienced emotions in expressive performance is something that musicians discover during their education, and that musicians have to make the transition from approaching music-related emotions as a listener to approaching music-related emotions as a performer. Future studies should test this hypothesis.

Third, this thesis provides concrete evidence that performers' experienced emotions have an effect on their body posture and movement characteristics. The results of both the motion-capture data and audience ratings revealed that performers exhibit the qualities of body movement associated with sadness (Crane & Gross, 2007) more strongly when they focus on felt emotion as compared to when they focus on technique or expressivity. This finding contributes to the debate as to whether felt and portrayed expressions of emotion result in

similar bodily expressions (e.g., Wallbott, 1998). In addition, this finding is interesting in the context of music cognition research: It shows the effect of a performer's focus on behaviour. As such, it might form the starting point for further research into the effect of performers' focus on motor learning (e.g., Wulf, 2013) in the context of music education and performance.

Fourth, this thesis provides concrete evidence that performers' experienced emotions have an effect on auditory performance characteristics. The results of both the audio data and audience ratings revealed that performers exhibit the auditory characteristics associated with sadness (Juslin, 2009) more strongly when they focus on felt emotion as compared to when they focus on technique or expressivity. This finding contributes to the debate as to whether felt and portrayed expressions of emotion result in similar expressions (e.g., Banse & Scherer, 1996). Moreover, it shows that the proposed distinction between emotional and expressive playing is not merely based on theoretical grounds but is also supported by empirical evidence. In future research it would be of interest to use brain-imaging techniques to better understand the difference between genuinely felt and portrayed expressions of emotions.

Fifth, this thesis provides concrete evidence that performers' experienced emotions have an effect on audience perception of performances. It reveals that audience members prefer performances given by performers focusing on expressivity as compared to performances given by performers focusing on technique or felt emotions. In addition, performers focusing on expressivity are perceived as better players. Performances given by performers focusing on felt emotions, however, are rated as being most expressive of the intended emotion. These findings are important in the context of music education and performance. Despite the evidence that music performance is about more than just sound (e.g., Schutz, 2008; Tsay, 2013), music education is still predominantly focused on sound. This is in contrast to, for instance, the education of actors. In drama education it is acknowledged that the emotions, thoughts, and behaviour of the actor are all part of the performance and need to be trained in rehearsal (e.g., Stanislavsky, 1950; Ford & Sloboda, 2013). The findings of this thesis suggest that performing musicians might benefit from more general performance training addressing aspects such as stage presence and the effect of emotions, thoughts, and behaviour on performance characteristics and audience perception.

Finally, this thesis successfully combines qualitative and quantitative approaches, and several of the studies present novel research materials and procedures. The Diary designed for Study I, for instance, proved to be effective both as a research tool and as a practice device. As a research tool it has already been adapted and used in other studies (e.g., James, Wise & Rink, 2013). As a practice device it has already been applied in a conservatoire setting (e.g., Conservatorio della Svizzera Italiana in Switzerland). Furthermore, the experimental design developed for Studies II and III proved to be effective in revealing elusive and hitherto rarely explored aspects of music performance. Hopefully the research presented here will inspire further studies and contribute to a more comprehensive view on the role and importance of emotions in practice, performance, and teaching of expressive performance.

TIIVISTELMÄ

Esiintyjän Tunteet Musiikillisessa Ilmaisussa: Ääni, Liike ja Havaitseminen

Pyrkiessään mahdollisimman ilmaisuvoimaisen esityksen tuottamiseen esiintyvät muusikot joutuvat useiden ilmaisuteknisten valintojen eteen: olisiko heidän syytä pyrkiä musiikin ilmentämien tunteiden omakohtaiseen kokemiseen, vai keskittyä mieluummin esimerkiksi soittoteknisiin osa-alueisiin, kuten tempoon, dynamiikkaan ja äänenväriin? Vaikuttavatko nämä valinnat musiikkiesityksen eri piirteisiin ja niiden havaitsemiseen? Tämän väitöskirjan tavoitteena on tutkia esiintyjän kokemien tunteiden roolia musiikkiesityksissä ja -harjoituksissa, sekä tarkastella esiintyjän lähestymistavan vaikutusta musiikkiesityksen eri osa-alueisiin (ääni ja liike) ja niiden havaitsemiseen. Väitöskirja koostuu viidestä tutkimuksesta, joissa jokaisessa hyödynnetään erilaisia tutkimusmenetelmiä.

Tutkimus I paljasti, että harjoitteluprosessiin liittyy sekä havaittuja että koettuja tunteita, ja että jälkimmäiset voidaan edelleen jaotella yhtäältä musiikkiin ja toisaalta harjoitteluun liittyviin tunteisiin. Näiden tunteiden esiintyvyys vaihteli harjoitteluprosessin eri vaiheissa. Musiikkiesitysten ääni- ja liiketallenteiden analyysi tutkimuksissa II ja III osoitti, että soittotekniikkaan, ilmaisuun tai koettuihin tunteisiin keskittyminen johti eroihin esitysten välillä. Tutkimus IV paljasti, että yleisön näkökulmasta esiintyjän ilmaisuvoima on yksi tärkeimmistä tekijöistä; koehenkilöt pitivät enemmän musiikilliseen ilmaisuun kuin tekniikkaan tai koettuihin tunteisiin keskittyvistä esityksistä, mutta arvioivat tunteen kokemiseen keskittyvät esitykset tunneilmaisultaan kaikkein voimakkaimmiksi. Tutkimus V paljasti muusikoiden esiintymistilanteeseen liittyvien tunteiden koostuvan sekä esiintymiseen että musiikkiin liittyvistä tunteista, joista jälkimmäiset ilmentävät monimutkaista suhdetta esiintyjän ja musiikin välillä. Ilmaisuun ja koettuihin tunteisiin keskittyvät soittotavat käsitteellistettiin eri tavoin. Esiintyessään muusikot pyrkivät mieluummin ilmaisulliseen kuin tunteelliseen soittotapaan.

Tämän väitöstutkimuksen tulokset osoittavat, että esiintyjän kokemilla tunteilla on merkittävä rooli ilmaisuvoimaisen esityksen harjoitus- ja esitysprosesseissa. Tutkimuksen tulokset paljastavat myös, että esiintyjän lähestymistavalla on merkitsevä vaikutus sekä musiikkiesityksen eri osa-alueisiin (ääni ja liike) että niiden havaitsemiseen. Tämän väitöskirjan tulokset antavat tukea ilmaisuun keskittyvän soittotavan ja koettuihin tunteisiin keskittyvän lähestymistavan erottamisen validiteetille, tarjoten sovellusmahdollisuuksia sekä tutkimuksen että musiikkipedagogiikan parissa.

Avainsanat: Esiintyvät muusikot, koetut tunteet, ilmaisu, esiintyjän liikkeet, musiikilliset piirteet, ääni, havaitseminen

REFERENCES

Altenmuller, E., & Schneider, S. (2009). Planning and performance. In S. Hallam, I. Cross, & M. Thaut (Eds.), *The Oxford Handbook of Music Psychology* (pp. 332-343). Oxford: Oxford University Press.

Armontraut, J. A., Schutz, M., & Kubovy, M. (2009). Visual determinants of a cross-modal illusion. *Attention, Perception, & Psychophysics, 71(7)*, 1618-1627.

Bachorowski, J. -A., & Owren, M. J. (2003). Sounds of Emotion. Production and Perception of Affect-Related Vocal Acoustics. *Annals of the New York Academy of Sciences, 1000*, 244-265.

Banse, R., & Scherer, K. R. (1996). Acoustic profiles in vocal emotion expression. *Journal of Personality and Social Psychology, 70(3)*, 614-636.

Beedie, C., Terry, P., & Lane, A. (2005). Distinctions between emotion and mood. *Cognition & Emotion, 19*, 847-878.

Berryman, J. C., Smythe, P. K., Taylor, A., Lamont, A., & Joiner, R. (2002). Developmental Psychology and You. Oxford: BPS/Blackwell.

Chaffin. R., Imreh, G., & Crawford, M. (2002). *Practicing Perfection: Memory and Piano Performance.* Mahweh/New Jersey/London: Lawrence Erlbaum Associates.

Chaffin, R., Lemieux, A. F., & Chen, C. (2006). Spontaneity and creativity in highly practiced performance. In I. Deliège, & G. A. Wiggins (Eds.), *Musical Creativity: Multidisciplinary Research in Theory and Practice* (pp. 200-218). New York: Psychology Press.

Chaffin, R., Lemieux, A., & Chen, C. (2007). "It's different each time I play": Spontaneity in highly prepared musical performance. *Music Perception, 24*, 455-472.

Clarke, E. F. (1988). Generative principles in music performance. In J. Sloboda (Ed.), *Generative processes in music. The psychology of performance, improvisation, and composition* (pp. 1-26). Oxford: Oxford University Press.

Crane, E., & Gross, M. (2007). Motion Capture and Emotion: Affect Detection in Whole Body Movement. Recognising Human Emotions from Body Movement and Gesture Dynamics. In A. Paiva, R. Prada, & R. W. Picard (Eds.), *Affective Computing and Intelligent Interaction, Lecture Notes in Computer Science, Vol. 4738*, (pp. 95-101). Berlin: Springer-Verlag.

Creswell, J. W. (1994). *Research design. Qualitative and Quantitative Approaches.* Thousand Oaks/London/New Delhi: Sage Publications.

Csikszentmihalyi, M. (1990). *Flow. The psychology of optimal experience.* New York: HarperCollins.

Dahl, S., & Friberg, A. (2007). Visual perception of expressiveness in musicians' body movements. *Music Perception, 24(5)*, 433-454.

Davidson, J. W. (1993). Visual Perception of Performance Manner in the Movements of Solo Musicians. *Psychology of Music, 21(2)*, 103-113.

Davidson, J. W. (2001). The role of the body in the production and perception of solo vocal performance: A case study of Annie Lennox. *Musicae Scientiae, 5(2)*, 235-256.

Davidson, J. W. (2007). Qualitative insights into the use of expressive body movement in solo piano performance: a case study approach. *Psychology of Music, 35(3)*, 381-401.

Davidson, J. W., & Correia, J. S. (2002). Body Movement. In R. Parncutt, & G. E. McPherson (Eds.), *The Science and Psychology of Music Performance: Creative Strategies for Teaching and Learning* (pp. 237-250). Oxford: Oxford University Press.

De Poli, G., Rodà, A., & Vidolin, A. (1998). Note by note analysis of the influence of expressive intentions and musical structure in violin performance. *Journal of New Music Research, 27(3)*, 293-321.

Deutsch, D. (Ed.). (2012). *The psychology of music. Third edition*. London: Academic Press.

De Visser, A. (1986). *'Hardop kijken': Een inleiding tot de kunstbeschouwing* ['Watching aloud': An introduction to art evaluation]. Nijmegen: SUN.

Duke, R. A., Cash, C. D., & Allen, S. E. (2011). Focus of Attention Affects Performance of Motor Skills in Music. *Journal of Research in Music Education, 59*, 44-55.

Eerola, T., & Vuoskoski, J. K. (2013). A review of music and emotion studies: Approaches, emotion models and stimuli. *Music Perception, 30(3)*, 307-340.

Erickson, D., Yoshida, K., Menezes, C., Fujino, A., Mochida, T., & Shibuya, Y. (2006). Exploratory study of some acoustic and articulatory characteristics of sad speech. *Phonetica, 63(1)*, 1-25.

Evans, P., & Schubert, E. (2008). Relationships between expressed and felt emotions in music. *Musicae Scientiae, 12(1)*, 75-99.

Ford, B., & Sloboda, J. (2013). Learning from Artistic and Pedagogical Differences between Musicians' and Actors' Traditions through Collaborative Processes. In H. Gaunt, & H. Westerlund (Eds.), *Collaborative Learning in Higher Music Education* (pp. 27-36). London: Ashgate.

Gabrielsson, A. (2001-2002). Emotion perceived and emotion felt: same or different? *Musicae Scientiae, Special Issue*, 123-147.

Gabrielsson, A. (2009). The relationship between musical structure and perceived expression. In S. Hallam, I. Cross, & M. Thaut (Eds.), *The Oxford Handbook of Music Psychology* (pp. 141-150). Oxford: Oxford University Press.

Gabrielsson, A. (2010). *Strong experiences with music: Music is much more than just music*. Oxford: Oxford University Press.

Gabrielsson, A., & Juslin, P. N. (1996). Emotional expression in music performance: Between the performer's intention and the listener's experience. *Psychology of Music, 24(1)*, 68-91.

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

Gerle, R. (1991). *The art of bowing practice. The expressive bow technique*. London: Stainer & Bell.

Glowinsky, D., Camurri, A., Volpe, G., Chiarra, N., Cowie, R., McMahon, E., Jaimovich, J., & Knapp, R. B. (2008). Using induction and multimodal assessment to understand the role of emotion in musical performance. In

Peter et al., (Eds.), *Proceedings of the workshop Emotion in HCI – Designing for People* (pp. 8-12). Fraunhof: Fraunhofer Verlag.

Grey, J. M., & Gordon, J. W. (1978). Perceptual effects of spectral modifications on musical timbres. *Journal of the Acoustical Society of America 63(5)*, 1493–1500.

Hallam, S. (1995). Professional Musicians' Approaches to the Learning and Interpretation of Music. *Psychology of Music, 23(2)*, 111-128.

Harty, H. (1911). *Three miniatures for oboe and piano: Orientale, Chansonette, A la campagne* [sheet music]. London: Stainer & Bell.

Higuchi, M. K. K., Fornari, J. E., & Leite, J. P. (2010). The influence of cognition and emotion in pianistic performance. In S. M. Demorest, S. J. Morrison, & P. S. Campbell (Eds.), *Proceedings of the 11th International Conference on Music Perception and Cognition* (pp. 186-191). Seattle, Washington.

James, M., Wise, K., & Rink, J. (2013, April). *Practising Creativity*. Paper presented at the Performance Studies Network Second International Conference, Cambridge, UK.

Juchniewicz, J. (2008). The influence of physical movement on the perception of musical performance. *Psychology of Music, 36(4)*, 417-427.

Juslin, P. N. (2000). Cue Utilization in Communication of Emotion in Music Performance: Relating Performance to Perception. *Journal of Experimental Psychology: Human Perception and Performance, 26(6)*, 1797-1813.

Juslin, P. N. (2001). Communicating Emotion in Music Performance: A Review and Theoretical Framework. In P. N. Juslin, & J. A. Sloboda (Eds.), *Music and Emotion: Theory and Research* (pp. 431-449). Oxford: Oxford University Press.

Juslin, P. N. (2003). Five Facets of Musical Expression: A Psychologist's Perspective on Music Performance. *Psychology of Music, 31(3)*, 273-302.

Juslin, P. (2009). Emotion in music performance. In S. Hallam, I. Cross, & M. Thaut (Eds.), *The Oxford Handbook of Music Psychology* (pp. 377-389). Oxford: Oxford University Press.

Justin, P. N., & Laukka, P. (2003). Communication of emotions in vocal expression and music performance: Different channels, same code?, *Psychological Bulletin, 129(5)*, 770-814.

Juslin, P. N., & Sloboda, J. A. (Eds.). (2010). *Handbook of Music and Emotion: Theory, Research, Applications.* Oxford: Oxford University Press.

Juslin, P. N., & Västfjäll, D. (2008). Emotional responses to music: the need to consider underlying mechanisms. *Behavioral and Brain Sciences, 31*, 559-575.

Kallinen, K., & Ravaja, N. (2006). Emotion perceived and emotion felt: Same and different. *Musicae Scientiae, 10(2)*, 191- 213.

Karlsson, J. (2008). A Novel Approach to Teaching Emotional Expression in Music Performance [Doctoral dissertation]. Sweden: University of Uppsala.

Karlsson, J., & Juslin, P. N. (2008). Musical Expression: an observational study of instrumental teaching. *Psychology of Music, 36(3)*, 309-334.

Kenny, D. T. (2010). *The psychology of music performance anxiety*. Oxford: Oxford University Press.

Kingsbury, H. (1988). *Music, Talent and Performance: A Conservatory System*. Philadelphia: Temple University Press.

Kivy, P. (1990). *Music Alone: Philosophical Reflections on the Purely Musical Experience.* Ithaca: Cornell University Press.

Kurosawa, K., & Davidson, J.W. (2005). Non-verbal interaction in popular performance: The Corrs. *Musicae Scientiae, 19(1)*, 111-136.

Krumhansl, C. (1997). An Exploratory Study of Musical Emotions and Psychophysiology. *Canadian Journal of Experimental Psychology, 51(4)*, 336-352.

Lamont, A. (2012). Emotion, engagement and meaning in strong experiences of music performance. *Psychology of Music, 40(5)*, 574-594.

Lartillot, O., & Toiviainen, P. (2007). A MATLAB toolbox for musical feature extraction from audio. In *Proceedings of the 10th International Conference on Digital Audio Effects (DAFx-07)*, Bordeaux, France, September 10-15.

Lindström, E., Juslin, P. N., Bresin, R., & Williamon, A. (2003). 'Expressivity comes from within your soul': A questionnaire study of music students' perspectives on expressivity. *Research Studies in Music Education, 20*, 23-47.

Luck, G., Toiviainen, P., & Thompson, M. R. (2010). Perception of expression in conductors' gestures: A continuous response study. *Music Perception, 28(1)*, 47–57.

Lundqvist, L. O., Carlsson, F., Hilmersson, P., & Juslin, P. N. (2009). Emotional responses to music: Experience, expression, and physiology. *Psychology of Music, 37(1)*, 61-90.

MacRitchie, J. (2011). Elucidating Musical Structure through Empirical Measurement of Performance Parameters [Doctoral dissertation]. Scotland: University of Glasgow.

O'Donoghue, T., & Punch K. (Eds.). (2003). *Qualitative Educational Research in Action: Doing and Reflecting.* London: Routledge.

O'Neill, S., & McPherson, G. (2002). Motivation. In R. Parncutt and G. E. McPherson (Eds.), *The Science and Psychology of Music Performance* (pp. 31-46). Oxford: Oxford University Press.

Persson, R. S. (1993). *The subjectivity of musical performance: An exploratory music-psychological real world enquiry into the determinants and education of musical reality.* Unpublished doctoral dissertation, University of Huddersfield, UK.

Persson, R. S. (2001). The Subjective World of the Performer. In P. N. Juslin, & J. A. Sloboda (Eds.), *Music and Emotion. Theory and Research* (pp. 275-289). Oxford: Oxford University Press.

Platz, F., & Kopiez, R. (2013). When the first impression counts: Music performers, audience, and the evaluation of stage entrance behavior. *Musicae Scientiae, 17(2)*, 167-197.

Plomp, R., & Levelt, W. J. M. (1965). Tonal Consonance and Critical Bandwidth *Journal of the Acoustical Society of America, 38(4)*, 548-560.

Reid, A. (2001). Variation in the Ways that Instrumental and Vocal Students Experience Learning Music. *Music Education Research, 3(1)*, 25-40.

Saumure, K., & Given, L. M. (2008). Data saturation. In L. M. Given (Ed.), *The Sage Encyclopaedia of Qualitative Research Methods* (pp. 195-196). Thousand Oaks: Sage Publications.

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

Scherer, K. R., & Zentner, M. R. (2008). Music evoked emotions are different – more often aesthetic than utilitarian. *Behavioral and Brain Sciences, 31*, 595-596.

Schippers, H. (2006). 'As if a little bird is sitting on your finger…': metaphor as a key instrument in training professional musicians. *International Journal of Music Education, 24(3)*, 209-217.

Schoonderwaldt, (2009). Mechanics and acoustics of violin bowing: Freedom, constraints and control in performance [Doctoral dissertation]. Sweden: Royal Institute of Technology (KTH).

Schutz, M. (2008). Seeing Music? What musicians need to know about vision. *Empirical Musicology Review, 3(3)*, 83-108.

Seale, C. (2004). Coding and Analysing Data. In C. Seale (Ed.), *Researching Society and Culture. 2nd Edition* (pp. 305-323). London: Sage.

Sloboda, J. A. (Ed.). (1988). *Generative processes in music. The psychology of performance, improvisation, and composition.* Oxford: Oxford University Press.

Sloboda, J. A. (1996). The Acquisition of Musical Performance Expertise: Deconstructing the 'Talent' Account of Individual Differences in Musical Expressivity. In K. A. Ericsson (Ed.), *The Road to Excellence. The Acquisition of Expert performance in the Arts and Sciences, Sports and Games* (pp. 107-126). Mahweh/New Yersey: Lawrence Erlbaum Associates.

Sloboda, J. A. (1999). Musical performance and emotion: Issues and developments. Reprinted in Sloboda, J. A. (2005), *Exploring the musical mind* (pp. 225-240). Oxford: Oxford University Press.

Sloboda, J. A. (2001). Emotion, Functionality, and the Everyday Experience of Music. *Music Education Research, 3(2),* 243-253.

Sloboda, J. A., & Lehmann, A. C. (2001). Tracking Performance Correlates of Changes in Perceived Intensity of Emotion During Different Interpretations of a Chopin Piano Prelude. *Music Perception, 19(1)*, 87-120.

Sloboda, J., Minassian, C., & Gayford, C. (2003). *Assisting advanced musicians to enhance their expressivity – an intervention study*. Paper presented at the 5th Triennial ESCOM Conference, Hanover, Germany.

Spackman, M. P., Brown, B. L., & Otto, S. D. (2009). Do emotions have distinct vocal profiles? A study of idiographic patterns of expression. *Cognition & Emotion, 23(8)*, 1565-1588.

Stanislavsky, S. (1950). Stanislavsky on the Art of the Stage (D. Magarshack, Trans.). London: Faber. (Original work published 1924/1936).

Thompson, M. R., & Luck, G. (2012). Exploring relationships between pianists' body movements, their expressive intentions, and structural elements of the music. *Musicae Scientiae, 16(1)*, 19-40.

Timmers, R., & Honing, H. (2002). On music performance, theories, measurement and diversity. In M. A. Belardinelli (Ed.), *Cognitive Processing (International Quarterly of Cognitive Sciences), 1-2*, 1-19.

Toiviainen, P., & Burger, B. (2010). *MoCap Toolbox Manual*. Retrieved from http://www.jyu.fi/music/coe/materials/mocaptoolbox/MCTmanual

Tonkiss, F. (2004). Analysing Text and Speech: Content and Discourse Analysis. In C. Seale (Ed.), *Researching Society and Culture. 2nd Edition* (pp. 367-382). London: Sage.

Tsay, C.-J. (2013). Sight over sound in the judgment of music performance. *Proceedings of the National Academy of Sciences*. Published ahead of print, August 19, 2013, doi:10.1073/pnas.1221454110.

Van Zijl, A. G. W., & Sloboda, J. A. (2011). Performers' experienced emotions in the construction of expressive musical performance: an exploratory investigation. *Psychology of Music, 39(2)*, 196-219.

Vines, B. W., Wanderley, M. M., Krumhansl, C. L., Nuzzo, R. L., & Levitin, D. J. (2004). Performance gestures of musicians: what structural and emotional information do they convey? In A. Camurri & G. Volpe (Eds.), *Gesture-Based Communication in Human-Computer Interaction* (pp. 468-478). Berlin: Springer Verlag.

Vines, B. W., Krumhansl, C. L., Wanderley, M. M., Dalca, I. M., & Levitin, D. J. (2011). Music to my eyes: Cross-modal interactions in the perception of emotions in musical performance. *Cognition, 118*, 157-170.

Vuoskoski, J. K. (2012). Emotions represented and induced by music: The role of individual differences [Doctoral dissertation]. Finland: University of Jyväskylä.

Wallbott, H. G. (1998). Bodily expression of emotion. *European Journal of Social Psychology, 28*, 879-896.

Walsh, D. (2000). Doing ethnography. In C. Seale (Ed.), *Researching Society and Culture. 2nd edition* (pp. 217-232). London: Sage.

Wanderley, M. M. (1999). Non-obvious Performer Gestures in Instrumental Music. In A. Braffort, R. Gherbi, S. Gibet, J. Richardson, & D. Teil (Eds.), *Gesture-Based Communication in Human-Computer Interaction* (pp. 37-48). Berlin: Springer Verlag.

Wanderley, M. M. (2002). Quantitative analysis of non-obvious performer gestures. In I. Wachsmuth & T. Sowa (Eds.), *Gesture and Sign Language in Human-Computer Interaction* (pp. 241-253). Berlin: Springer Verlag.

Wanderley, M. M., Vines, B. W., Middleton, N., McKay, C., & Hatch, W. (2005). The musical significance of clarinetists' ancillary gestures: an exploration of the field. *Journal of New Music Research, 34(1)*, 97-113.

Wapnick, J., Mazza, J.K., Darrow, A.A. Wapnick, J., Mazza, J.K., & Darrow, A.A. (1998). Effects of performer attractiveness, stage behaviour and dress on violin performance evaluation. *Journal of Research in Music Education, 46(4)*, 510-521.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development And Validation Of Brief Measures Of Positive And Negative Affect - The Panas Scales. *Journal of Personality and Social Psychology, 54(6)*, 1063-1070.

Whaley, J., Sloboda, J. A., & Gabrielsson, A. (2009). Peak experiences in music. In S. Hallam, I. Cross, & M. Thaut (Eds.), *The Oxford Handbook of Music Psychology* (pp. 452-461). Oxford: Oxford University Press.

Williamon, A. & Davidson J. W. (2002). Exploring co-performer communication. *Musicae Scientiae, 6(1)*, 53-72.

Woody, R. H. (2000). Learning Expressivity in Music Performance: An Exploratory Study. *Research Studies in Music Education, 14(1)*, 14-23.

Woody, R. H. (2002). Emotion, Imagery and Metaphor in the Acquisition of Musical Performance Skill. *Music Education Research, 4(2)*, 213-224.

Woody, R. H. (2006). Musicians' Cognitive Processing of Imagery-Based Instructions for Expressive Performance. *Journal of Research in Music Education, 54(2)*, 125-137.

Woody, R., & McPherson, G. E. (2010). Emotion in the lives of performers. In P. Juslin, & J. A. Sloboda (Eds.), *Handbook of Music and Emotion: Theory, Research, Applications* (pp. 401-424). Oxford: Oxford University Press.

Wulf, G. (2013). Attentional focus and motor learning: a review of 15 years. *International Review of Sport and Exercise Psychology, 6(1)*, 77-104.

Zentner, M., Grandjean, D., & Scherer, K. R. (2008). Emotions Evoked by the Sound of Music: Characterization, Classification, and Measurement. *Emotion, 8(4)*, 494-521.

Zuckerman, M., Hall, J. A., DeFrank, R. S., & Rosenthal, R. (1976). Encoding and Decoding of Spontaneous and Posed Facial Expressions. *Journal of Personality and Social Psychology, 34(5)*, 966-977.

ORIGINAL PAPERS

I

PERFORMERS' EXPERIENCED EMOTIONS IN THE CONSTRUCTION OF EXPRESSIVE MUSICAL PERFORMANCE: AN EXPLORATORY INVESTIGATION

by

Anemone G. W. Van Zijl & John A. Sloboda, 2011

Psychology of Music, 39(2), 196-219

sempre:
Society for Education, Music and Psychology Research

Article

Psychology of Music
39(2) 196–219

DOI: 10.1177/0305735610373563
pom.sagepub.com
SAGE

Performers' experienced emotions in the construction of expressive musical performance: An exploratory investigation

Anemone G. W. Van Zijl
University of Jyväskylä, Finland

John Sloboda
Keele University, UK, and Guildhall School of Music and Drama, UK

Abstract

Does a performer feel sad when s/he performs a sad piece of music, or does s/he perform sadness? Not much is known about the relationship between felt and performed emotions in performing musicians. Some studies emphasize the importance of feeling the emotions; others underline the idea of planned expressiveness. The purpose of this study was to investigate the relationship between a performer's experienced emotions and the construction of a musically expressive performance. Eight music students (mean age: 20.9, SD: 1.13) completed an introductory, semi-structured interview; a monitoring period during which they filled out an Individual Playing Diary; and an in-depth, semi-structured interview based on the diary. Differences were found between performers' emotions related to the practice activity (e.g., frustration at not being able to master technical difficulties) and emotions related to the music (e.g., aesthetic delight). Initially, practice-related emotions prevailed. Then, music-related emotions came to the fore. As the learning process developed, 'feeling' the musical emotions transformed into 'knowing' the musical emotions: the expressive interpretation, and the intensity of felt emotions waned. At the point of performance, some felt emotion was added again. These findings provide a detailed insight into an under-studied aspect of music performance as a creative practice.

Keywords

felt emotion, expressive performance, musical learning, perceived emotion, performing musicians

Performing musicians have to face the question how to best achieve an expressive performance. Should the performance be based on their own emotional experience of the music being played?

Corresponding author:
Anemone G. W. Van Zijl, Finnish Centre of Excellence in Interdisciplinary Music Research, Music Department, University of Jyväskylä, PO box 35(M), 40014 Jyväskylä, Finland.
[email: anemone.vanzijl@jyu.fi]

Or should they rather rely on the technical use of appropriate musical means – such as tempo, volume, articulation, timbre?

The opinions concerning these questions differ considerably. Some musicians and researchers adhere to the vision that 'A musician cannot move others unless he too is moved' (C. Ph. E. Bach, quoted in Persson, 2001). Other musicians and researchers argue that performing is more a matter of deliberate conscious awareness and planned expressiveness: 'I also have to play pieces which are not so emotionally connected to me, because I am a professional' (pianist interviewed by Sloboda and Lehmann, 2001). It is likely that there are individual differences between performers. It is also likely that there are different ways to construct a musically expressive performance. However, what role might a performer's experienced emotions play in the construction of a musically expressive performance? The present study aimed to investigate this question.

The two concepts that take centre stage in the present research are 'emotion' and a 'musically expressive performance'. According to Gabrielsson (2001–02), there is neither in everyday language nor in psychological terminology a unanimous agreement on the definition of terms such as 'emotion', 'feeling', 'mood', and 'affect' or their correspondences in other languages. In line with Gabrielsson, in the present study the term 'emotion' was used in a generic and broad-minded sense. An important distinction regarding emotional expression in music, however, is the distinction between induced and perceived emotion. Induced emotion could be described as someone's emotional response to the music: the music causes, for instance, a sad feeling. Perceived emotion could be described as the ability to perceive an expression in music – of, for instance, sadness – without necessarily being affected oneself (e.g., feeling sad). Gabrielsson (2001–02) has examined the distinction between perceived and induced emotion regarding (research on) *listeners*. The distinction between perceived and induced emotion with regard to *performers*, however, has yet to be examined.

The second concept, a 'musically expressive performance', is a complex and multi-dimensional concept (see for instance Juslin, 2001, 2003; Lindström, Juslin, Bresin, & Williamon, 2003). In the present study a 'musically expressive performance' was seen as the (desired) outcome of an interpretation. According to Juslin (2003), the term 'interpretation' refers to the individualistic shaping of a piece according to the musical ideas of the performer. This might involve an intention to express something (e.g., an idea, an emotion) beyond the musical structure, but such an expression is usually accomplished through the ways in which the structure is articulated (how it is played). The process of interpretation seems to be influenced by both 'internal' factors (e.g., emotions, wanting to express something personal) and 'external' factors (e.g., musical style, the structure of the piece, the composer's intentions) (Juslin, 2003, p. 276).

With regard to the shaping of an expressive performance, different assumptions can be found in the literature. According to Sloboda (1999), a commonly held folk belief is that the emotional power and freshness of music performance lies in its intuitive spontaneity. This belief seems to be reflected in musicians' opinions regarding emotion and expressivity. Research conducted by Persson (1993, 2001) and Lindström et al. (2003) suggests that musicians seem to be of the opinion that a performer has to experience certain emotions in order to be able to perform in an expressive way.

Lindström et al. (2003) conducted a questionnaire study in order to investigate how conservatoire students approach the subject of expressivity. They found that 44 percent of the students defined 'playing expressively' largely in terms of 'communicating emotions', while

16 percent defined 'playing expressively' in terms of 'playing with feeling'. According to Lindström et al., the first way of defining involves more focus on actually conveying something to the audience, whereas the second one involves more focus on the performer's own feelings. According to 99 percent of the participants in Lindström's et al. study, music can express emotions. Interestingly, the majority of the music students claimed that they feel the intended emotion while playing (always, 23%; often, 65%; seldom, 12%; never, 0%). As many as 60 percent of the students regarded it as necessary to feel the emotion in order to communicate it successfully to a listener (Lindström et al., 2003).

In order to 'feel the musical emotion' or to 'get into the mood' of the piece being played, Persson (2001) has suggested that some musicians very consciously manipulate recall of certain memories (emotional memories and memories of emotions). Based on interviews with classical musicians, Persson concluded that some musicians seem to use a technique that could be labelled as 'mood induction' (i.e., to remember the sensation of a certain emotion without necessarily conjuring up specific imagery); others seem to use a technique that could be labelled as 'visualization' (i.e., visual imagery) (Persson, 2001, pp. 279–283). The findings by Lindström et al. (2003) and Persson (1993, 2001) provide interesting starting points for further investigation of the inner emotional world of the performer.

Other studies, however, give rise to the idea that an expressive performance is – rather than 'feeling the emotions' – more a matter of deliberate conscious awareness and planned expressiveness. These studies emphasize that musicians study musical texts, experiment with different interpretative devices (such as emphasizing musical phrases by means of slowing at phrase ends and speeding in phrase middles) and make deliberate decisions regarding the incorporation of specific expressive devices before the actual performance takes place (Chaffin, Imreh, & Crawford, 2002; Sloboda & Lehmann, 2001).

Sloboda and Lehmann (2001), for instance, developed a method to link expert musicians' interpretive choices and associated performances to listeners' perception of emotionality. Sloboda and Lehmann found, among other things, that the trajectory of continuous responses of perceived emotionality followed the general structure of the musical score. Moreover, they found that many of the analysed divergences (which were noticed by the listeners) were reflected in the performers' interpretive intentions as indicated in practice reports and short interviews (Sloboda & Lehmann, 2001).

Chaffin, Imreh and Crawford (2002) investigated the learning process of a piece of music by an expert pianist. Chaffin et al. identified six stages in the process of learning to play a piece from memory. The stages identified were called 'scouting it out', 'section by section', 'the gray stage', 'putting it together', 'polishing' and 'maintenance' (for a detailed account, see Chaffin et al., 2002, pp. 239–246). In addition, Chaffin et al. concluded that expert musicians learn a piece of music by studying and thinking in terms of 'performance cues'. Chaffin et al. distinguished 'basic cues' (e.g., critical fingerings, technical difficulties), 'interpretative cues' (e.g., critical phrasings, dynamic emphases) and 'expressive cues' (e.g., the 'musical feelings' the performer wants to convey to the audience, such as surprise or excitement). It could be assumed that emotions are mainly at play regarding the construction of expressive cues. However, like the publication by Sloboda and Lehmann (2001), the publication by Chaffin et al. (2002) does not address the role of the performer's experienced emotions concerning the interpretative and expressive decisions taken.

The present research aimed to explore what role a performer's experienced emotions might play in the construction of a musically expressive performance. Based on the literature, a set of

sub-questions was formulated. The questions were open-ended, rather than hypothesis driven, as appropriate for an initial exploratory study:

- How do performers (i.e., music students) describe 'emotional playing' and a 'musically expressive performance'?
- By means of what 'strategies' do performers construct an expressive performance? (For example, do they base their interpretation on emotion; intellectual considerations; musical structure ...)
- What kinds of 'inner techniques' (if any) do performers use in order to construct an expressive performance? (For example, mood induction; visualization; thoughts; imitation ...)
- How do the felt emotions of the performer (if any) relate to the perceived emotions in the music (if any)?

These research questions were explored through qualitative in-depth interviews in combination with a diary study. The present research consisted of three phases. The first phase consisted of an introductory, semi-structured interview. During this interview it was investigated how the participant thought about musical expressivity and related topics *in general*. During the second phase, the participants were asked to monitor their practice and performance of a self-chosen piece of music by means of an Individual Playing Diary. In previous studies investigating music students' approaches to expressiveness (e.g., Lindström et al., 2003; Woody, 2000), musicians were only asked to answer questions about musical expressivity and related topics *in general*. The answers of the musicians were therefore not necessarily based on recent and consciously monitored playing or practice experiences. In order to find out whether the answers of musicians would change if they were asked to reflect on specific and recent experiences, in the present study, music students were stimulated to monitor their everyday practice by completing an Individual Playing Diary. Consequently, it was possible to base the questions of the semi-structured in-depth interview – the third phase of the research – on recent and consciously monitored playing experiences.

It could take several months to learn to play a piece of music. Therefore, music students were tracked at different stages of engagement with a piece of music. The participants were divided into two groups: 'the beginning stage of practice group' and 'the final stage of practice group'. The choice to focus on the beginning stage of practice was based upon findings in the literature that suggest that when musicians make the acquaintance of a new piece of music they actively and consciously construct some type of descriptive or personal context for the music, a framework that then directs how the piece of music will be played (Persson, Pratt, & Robson, 1992, pp. 209–210). The choice to focus on the final stage of practice was based upon findings in the literature that suggest that the focus on expressiveness seems to be primarily present during the final stages of practice (Chaffin, Lemieux, & Chen, 2006).

Thus, an approach of qualitative in-depth interviews based on recent playing and practice experiences consciously monitored by means of an Individual Playing Diary was used in order to gain a deeper insight into the way music students construct a musically expressive performance and, in particular, the role a performer's experienced emotions might play within the construction process. We chose to focus on a small number of individuals of similar ability in order to build up a detailed picture of the phenomena under investigation, favouring rich descriptions over generalizability at this stage in the research trajectory. This approach was

considered most appropriate to an exploratory study, where the topic is not much investigated and the proposed method of investigation requires validation.

Method

The study consisted of three phases: an introductory interview, a monitoring period during which participants filled out an Individual Playing Diary, and an in-depth interview based on the diary. A pilot study was conducted in order to test the effectiveness of the subsequent phases and the materials used. Three music students participated in the pilot study, a violinist, a flautist and a trumpeter, representing the instrument groups of strings, woodwind and brass. The pilot study did not bring to light any noteworthy deficiencies in the initial research design. Therefore, the data of the pilot study were included in the main study.

Participants

Participants were eight music students studying at a conservatoire ($n = 2$) and a university ($n = 6$) in England, and were recruited by means of a participant invitation email and a participant invitation letter. Classical music was the stylistic aim in education for all participants. Table 1 shows the sex and age (mean age: 20.9, SD: 1.13) of the participants as well as the number of years they played their instrument (mean years: 14.25, SD: 2.05), the average number of hours they indicated practising during a week (mean hours: 19.13, SD: 14.0), the composition they described in the Individual Playing Diary, and the stage of practice group they were in.[1]

Table 1. Demographics of the participants who took part in the study

Instrument	Sex	Age	Years of playing	Hours of practice a week	Composition	Stage of practice group
Violin	F	22	17	6	Johann Sebastian Bach – *Partita for Solo Violin in E Major, No. 3; BWV 1006*	Beginning
Trombone	M	20	13	9	Eugène Bozza – *New Orleans for Bass Trombone and Piano*	Beginning
Cello*	F	20	17	18	Ernst Bloch – *Jewish Pieces for Cello and Piano*	Beginning
Trumpet	M	21	14	10	Jean Baptiste Arban – *Carnival of Venice*	Final
Flute	F	21	14	7	Jules Mouquet – *Sonate pour flute et piano: La Flute de Pan*	Final
Piano	M	22	15	28	Dmitri Shostakovich *Second Piano Concerto*	Final
Flute	F	22	13	30	Eugène Bozza – *Image for Solo Flute*	Final
Cello*	M	19	11	45	György Ligeti – *Sonata for Solo Cello*	Final

*Conservatoire students

Materials and Procedure

Phase 1: the introductory interview. The first phase consisted of an introductory, semi-structured interview. The introductory interview lasted approximately 25 minutes. Appendix A shows the interview guide used. During this interview the research procedure was explained, the participant got the opportunity to ask questions, a consent form was signed and some demographic data were collected. Based on the time the participant indicated s/he had already been working on the piece s/he intended to describe in the diary (ranging from 'never played or heard before' to 'about a year') the participant was categorized into 'the beginning stage of practice group' or 'the final stage of practice group'. In relation to this choice, some questions concerning the chosen composition (e.g., 'What are the reasons for studying this composition?') and expressive performance (e.g., 'How would you describe an expressive performance?') were asked. This was done in order to get an idea of the participant's 'emotional relationship' to the piece, and to find out how the participant defined concepts such as 'expressive performance' and 'emotional playing'. Some specific questions were asked during both the first and second interview. This was done in order to find out whether the experience of filling out the Individual Playing Diary influenced the participants' opinions. Finally, the use of the Individual Playing Diary was explained and an appointment for the second interview was made. The interviews were recorded on minidisc and transcribed. The transcripts were subjected to qualitative thematic analysis.

Phase 2: the monitoring period and Individual Playing Diary. During the second phase the participants monitored their practice and performance of a self-chosen piece of music by means of filling out an Individual Playing Diary for a period of approximately a week.

The Individual Playing Diary was especially designed for the present study. It consisted of four parts: an instruction sheet, a preliminary information sheet, a set of 10 individual playing sheets and a concluding sheet. In the instruction sheet, the procedure of the Individual Playing Diary was explained. Participants were asked to report all their practice sessions on the chosen piece of (solo) classical music. They were asked to fill in the preliminary information sheet before they started to monitor their practice sessions, to fill in an individual playing sheet during or immediately after each practice session, and to fill in the concluding sheet after the music lesson in which they performed the piece of music described in the Playing Diary.[2]

The individual playing sheets (see Appendix B) were the most important part of the diary: by means of these sheets, the characteristics involved in the process of constructing an expressive performance were investigated. On the individual playing sheets, participants were asked to describe their playing and practice sessions by filling in six 'boxes' named 'Location', 'Interpretation', 'Technical Issues', 'Inner Techniques', 'Musical Emotion' and 'Own Emotion' once for each discrete practice activity. The 'Location' and 'Interpretation' boxes were based upon the diary design used by Sloboda and Lehmann (2001). The remaining boxes were designed by means of self-monitoring the practice process of Vaughan Williams's *Concerto for Oboe and Strings* by the first author. This process involved the author asking herself such questions during practice as: 'What am I doing now?', 'What effect am I trying to create?', 'What do I feel?', and noting down the emergent range of responses. A grounded theory approach (see Seale, 2004a) was then used to categorize responses into major groupings, which turned out to be most effectively tapped by four additional boxes: 'Technical Issues', 'Inner Techniques', 'Musical Emotion' and 'Own Emotion'. In addition to these boxes, there was a space at the bottom of the individual playing sheet for participants to write down general comments and describe aspects that did not fit into any of the boxes. The individual playing sheets were printed on A3 paper in order to give participants enough space to write down their comments.

Under the heading 'Location', participants were asked to describe the section of the music they were playing/working on (e.g., page; bars; passage; whole piece ...). The descriptions in this first box provided specific points of reference for the questions in the in-depth interview (Phase 3). Under the heading 'Interpretation', participants were asked to describe their interpretational decisions with regard to the musical expressivity they wanted to bring to the fore (if any) in relation to the location described (e.g., particular character; particular contrast; building up or release of tension ...). Under the heading 'Technical Issues', participants were asked to describe the technical aspects they used/worked on (if any) in order to perform the desired interpretation/expressivity (e.g., phrasing; tempo; timing; dynamics; articulation; timbre; vibrato; bowing; finger technique; breathing ...). Under the heading 'Inner Techniques', participants were asked to describe any inner techniques they used in order to perform the desired interpretation/expressivity (e.g., think about something in particular; imagination of something visual or audible; try to get yourself in a particular mood ...). Under the heading 'Musical Emotion', participants were asked to describe the emotion (if any) that was present in the music at the location described (e.g., happiness; desire; humour; sadness; anger; fear; nostalgia; no emotion ...). Under the heading 'Own Emotion', participants were asked to describe any emotions they felt themselves while playing the indicated section (e.g., happiness; desire; humour; calmness; tension; sadness; anger; fear; nostalgia; frustration; no emotion ...). The examples of technical issues (e.g., phrasing; tempo ...), inner techniques (e.g., think about something in particular ...) and musical and own emotions (e.g., happiness; joy ...) were added in order to give the participants some idea of the meaning of the boxes. During the first interview it was explicitly indicated by the interviewer that these examples were just that, and that participants were free to use any descriptions they found to be appropriate. The boxes were judged to be a systematic and logical way of inviting musicians to record their emotional judgements and feelings in a way that is properly grounded in the micro-structure of the practice and the self-defined purposes of individual practice sequences.

The Individual Playing Diaries were collected and subjected to content analysis. Moreover, the diaries were used as starting point and input for the in-depth interviews.

Phase 3: the in-depth interview. The third phase consisted of an in-depth, semi-structured interview based on recent experiences described in the Individual Playing Diary. The in-depth interview lasted approximately 60 minutes. Appendix C shows the interview guide used.

The in-depth interview started with an outline of the content of the interview: after some introductory questions, specific questions based on the descriptions provided in the Individual Playing Diary were asked, followed by some overall questions. The introductory questions (e.g., 'How did you find it to fill out the Individual Playing Diary?') were used to encourage the participant to talk and express any experienced problems with the diary. The specific questions based on the Individual Playing Diary asked for elaboration upon and explanation of aspects described in the diary. These questions were different in each interview. Some questions asked for an explanation of descriptions related to particular boxes (e.g., 'How to show "the linear line of the piece"?', 'In what way is the music "cheeky"?', 'What do you mean with "play with a smile"?'); other questions asked for elaboration upon the way the descriptions of the different boxes were interrelated (e.g., 'With regard to the Musical Emotion you wrote down "pained, tense, on edge", with regard to your Own Emotion you wrote down "happy, I had got my feelings into the music". Could you explain how the Musical Emotion and your Own Emotion were related here?'). Although the diary-related questions were unique for each interview, during the interviews several underlying questions, based on the initial research questions, were in the mind of the researcher (and were sometimes asked explicitly).

After having discussed the diary-specific questions, most of the participants were able to answer several abstract overall questions in a clear and succinct way. Some examples of overall questions were: 'How do the felt emotions of the participant relate to the perceived emotions in the music/the performed emotion?'; 'Does the participant think s/he would have felt different if s/he had to write about another piece?'; 'How would the participant describe "emotional playing" and an "expressive performance"?' The idea of these overall questions was to gain a summary of the main points of view of each participant. Therefore, the interview technique used for these abstract overall questions was to start with open-ended questions, rephrase the answers received and pass them back to the participant to see if s/he accepted them, elaborated upon them or rejected them. A final question asked was whether there was anything the participant liked to add or ask. In response to this last question, several participants reflected on the experience of taking part in the research project.

The interviews were recorded on minidisc and transcribed. The transcripts were subjected to qualitative thematic analysis.

Analyses

The data were analysed in a systematic way using three complementary strategies of analyses. The Individual Playing Diaries were analysed by means of content analysis: a method for studying textual data that seeks to analyse texts in terms of the presence and frequency of specific terms, narratives or concepts (see Tonkiss, 2004). For each box of the Individual Playing Diary, the descriptions used by each participant were listed, categorized and counted. The categorization was based on grouping together similar descriptions.

The descriptions regarding the Location box were categorized into two groups: 'working on' (e.g., 'bars 1–7') or 'playing through' (e.g., 'playing through the piece'). The descriptions regarding the Technical Issues box were categorized into three groups: 'instrument specific skills' (e.g., 'bow pressure', 'lip flexibility'); 'technical issues closely related to performance directions' (e.g., 'tempo changes', 'dynamics'); and 'aspects related to the creation of a specific sound' (e.g., 'within the bow sound', 'projecting'). The descriptions regarding the Inner Techniques box were categorized into four main groups (i.e., 'Imagination', 'Focus on sound/tone colour', 'Concentration/focus in general', 'Body movement') and a group containing eight other descriptions called 'other'. With regard to the Interpretation and Musical Emotion boxes, the number of different descriptions as well as the number of total descriptions were investigated. For instance, where a participant mentioned the word 'happy' three times and the words 'cheerful' and 'jubilant' only once with regard to the Musical Emotion, the number of different descriptions was three, whereas the number of total descriptions mentioned was five. The descriptions regarding the Own Emotion box were categorized into 'music-related emotions' and 'practice-related emotions', whereas the latter were also divided into 'positive', 'negative' or 'neither'. The diaries were read and discussed in detail by both authors.

The interview transcripts were analysed by means of qualitative thematic analysis. This involves an interpretative analysis of textual meaning based on a coding scheme derived both deductively from pre-existing concerns, questions and hypotheses, and inductively from examination of the actual data (see Seale, 2004b). The themes used for coding the transcripts were based on the elements revealed through content analysis of the diaries as well as on the initial research questions. Seven main themes were distinguished: (1) 'strategies of constructing an interpretation/performance'; (2) 'inner techniques'; (3) 'technical issues'; (4) 'emotions'; (5) 'motivation for playing'; (6) 'conceptualization of an expressive performance'; and (7)

'reflection upon the diary'. Each theme was represented by a colour. The interview transcripts were coloured and keywords detailing more specific information were added. The transcripts were read and thoroughly discussed by both authors.

The third strategy of analysis performed was a constructionist analysis (see Walsh, 2000): by means of examining the episodes described in the diaries and the explanations provided in the interviews, it was investigated how the elements involved in the construction process of an expressive performance were interrelated. Several patterns were found. Once a certain pattern was found (i.e., an episode detailing a certain combination of characteristics as revealed through content analysis of the diaries), it was checked whether this pattern could be found by the other participants as well. The patterns found in the diaries of all participants suggested a progression in the process of constructing a musically expressive performance. By means of respondent validation (see Walsh, 2000), the findings of the three complementary strategies of analyses were verified.[3]

Results

The tri-partite research design generated a large amount of data. It was found that all participants seemed to be consistent in their vision concerning a musically expressive performance (i.e., what they said prior to completing the diary was consistent with what they said afterwards). However, during the second interview the participants were much more specific in their answers. All participants indicated that the diary made them more aware of what they did when practising, when constructing an interpretation and when preparing a performance.

The Individual Playing Diary seemed to work very well, both as a research tool and as a practice device. Table 2 shows an overview of the number of boxes filled in by each participant. The percentages of boxes completed varied from 51 percent to 100 percent, with an average of 86 percent. The missing boxes did not indicate a pattern of difficulty with any box in particular, although some of the participants preferred to make use of the 'general comments space' at the bottom of the diary. An example of such a general comment explaining why a participant did not fill in many of the 'Own Emotion' boxes was 'Take emotion *from* the music. Not apply own emotion to it'. In general, the participants did not seem to have difficulties with the design of the Individual Playing Diary. Moreover, they all expressed their enthusiasm about the usefulness of completing the diary. In the words of one of them:

> It was interesting because it was probably the first time in a long time that I've been that reflective about my own playing. … It was a bit strange for me to start with, but it got easier. And it was helpful, I mean it made me certainly think more about how I approach getting things out of music, technical as well as emotional. … I think considering a week's kind of rehearsal, my playing improved a lot more by doing this diary. I actually had to think about it. And by thinking about it, it made me think 'well okay, so what can I do tomorrow in the next session to make that sound better'. So yeah. To be honest, it might be something that I try again on a different piece. It's useful. (Trombone player)

Characteristics revealed through the individual Playing Diary

Content analysis of the diaries and qualitative thematic analysis of the interview transcripts revealed several characteristics regarding the construction of an expressive performance. Detailed quantitative and qualitative analysis of the diaries and interview transcripts is provided in Van Zijl (2008). Here only the most important findings are briefly summarized.

Table 2. Overview of the number of sessions (i.e., individual playing sheets filled in), episodes (i.e., discrete practice activities) and missing boxes filled in by each participant; also included are the percentages of total boxes filled in by each participant

Participant	Number of sessions	Number of episodes	Average number of episodes per session	Missing boxes						Percentage of boxes filled in
				Location	Interpretation	Technical issues	Inner techniques	Musical emotion	Own emotion	
Violinist	7	16	2.3	0	0	0	0	0	0	100
Trombonist	5	11	2.2	0	0	0	0	0	0	100
Cellist	7	21	3	0	1	8	2	1	0	90
Trumpeter	6	6	1	0	0	0	0	0	0	100
Flautist	3	19	6.3	0	0	0	0	0	0	100
Pianist	6	36	6	0	6	13	29	24	34	51
Flautist	7	12	1.7	0	4	2	6	6	8	64
Cellist	5	10	2	0	3	2	2	4	0	82

Of interest were the findings regarding the inner techniques used to bring the desired interpretation and emotional expression across. No less than 12 different such techniques were mentioned. 'Imagination' (i.e., metaphor/visualization/character); 'Focus on sound/tone colour'; 'Concentration/focus in general'; and 'Body movement' were described by most participants. The descriptions of the inner techniques provided were very rich and vivid. Some participants gave, for instance, detailed descriptions of an image of 'melted chocolate' they thought of in order to be able to produce a dark, rich tone. Others spoke about the music as being 'the soundtrack to the film in their head'. Several participants thought about their sound in terms of colours. For some participants a certain colour was associated with certain physical aspects such as 'playing with an open throat'. For one participant with synaesthesia (i.e., seeing colours when hearing music in general), each key had its own colour, making the 'blue coloured' Haydn cello concerto in D somewhat 'colder' than the 'yellow coloured' concerto in C. Several participants seemed to use certain kinds of meditation techniques in order to get into the 'appropriate zone to play' or reach the desired level of concentration. Some other participants spoke about the use of body movement. They either spoke about 'swinging along' with the music because that 'seemed to be the right thing to do' or about making particular gestures in order to communicate the music to the audience. For a detailed account of the inner techniques identified, see Van Zijl (2008).

Of particular interest were the findings related to the Musical Emotion and Own Emotion boxes of the diary. With regard to musical emotion, it was found that, although basic emotions such as 'happy' and 'sad' were mentioned, all participants made use of very subtle characterizations (e.g., 'thoughtful', 'dark', 'still'; 'cheeky', 'witty', 'humorous') in order to express the emotion present in a particular section of the piece. The own emotions, conversely, were described in a less subtle way (e.g., 'happy', 'sad', 'calm', 'tense').

The relationship between musical emotion and own emotion was complex. With regard to own emotion, there seemed to be a difference between emotions related to the music and emotions related to the practice activity. In case of emotions related to the music, participants described either that they experienced more or less the same emotions as were found to be present in the music (e.g., Musical Emotion: 'happy'; Own Emotion: 'happy'), or that they experienced an emotion caused by but different from the emotion present in the music (e.g., Musical Emotion: 'melancholy and sad'; Own Emotion: 'peaceful, happy'). In the case of emotions related to the practice activity, the emotions seemed to be positive (e.g., 'Yay – I can play it'), negative (e.g., 'Frustration!'), or neither (e.g., 'Remain calm'). It was found that all participants experienced both music-related and practice-related emotions. Moreover, it was found that the experienced own emotion changed as learning proceeded.

Four phases in the process of constructing an expressive performance

Constructionist analysis of the data revealed a progression in the practice process that might be best characterized by 'four phases'. The four phases will be discussed by means of exemplary diary episodes and interview quotations.

Phase 1: the initial exploration of the piece. A first phase within the construction process of an expressive performance could be illustrated by Table 3, a diary episode of a participant in the absolute beginning stage of practice.

With regard to the location, we can see that the participant started to play through the piece (i.e., 'playing through'). This first playing through session was meant to explore the piece: with

Table 3. A diary episode of a participant in the absolute beginning stage of practice

	Cellist, session 1, episode 1 ↓
Location	Playing through
Interpretational decisions	I looked at the music for the first time to get the overall shape, so I could fill in my interpretation later.
Technical issues	–
Inner techniques	This doesn't apply.
Musical emotion	There are many different emotions in this music.
Own emotion	Tense, confused, as looking at piece for first time.

regard to the interpretational decisions, the participant indicated that she 'looked at the music for the first time to get the overall shape' so that she 'could fill in her interpretation later'. During the interview, the participant explained that she based her interpretation on how she felt the music should sound, while giving justice to the performance directions:

> Normally my interpretation would be based on how it feels, but sometimes I find that's dangerous, because I can sometimes forget to look at all the musical instructions on the page, so I try to incorporate those into it as well, sort of incorporate them into the feeling and see if it fits, and, if not, I have to change how I feel about it. (Cellist)

During the interviews, all participants indicated that they started the learning process of a new piece of music by 'playing it through'. All participants indicated that their interpretation of a piece of music was mainly based on their feelings (i.e., 'how they felt it should sound')[4] by playing it through. In addition to their feelings, the participants indicated that the composer's intended and prescribed intentions (as present in the score) needed to be followed, and conventions regarding musical structure (e.g., 'the phrase naturally peaked and went down again') and style (e.g., 'Bach should be played like this') needed to be taken into account as well. Although all participants considered their feelings as the most important aspect to base their interpretation on, where these did not fit with the performance directions or musical conventions, the participants found that they had to compromise their feelings.

As we can see in Table 3, the technical issues and inner techniques did not apply yet in this phase of initial exploration of the piece. With regard to the musical emotion, Table 3 shows that the participant indicated that there were emotions present in the music. It was, however, still too early to be specific about the kinds of emotions found to be present. Instead, the participant indicated that there were 'many different emotions in the music'. If we look at the emotions described in the Own Emotion box (i.e., 'Tense, confused, as looking at piece for first time'), it becomes clear that the initial engagement with a piece could go along with confusion.

In sum, during the first phase in the construction process of an expressive performance, the participants started with playing through the piece in order to explore it, and get an idea of the overall shape of the music. During this first phase, the performers seemed to use their own (music-related) emotions in order to explore how they 'felt the piece should sound'.

Phase 2: the mastering of technical difficulties. A second phase within the construction process of an expressive performance could be illustrated by Table 4, a diary episode of a participant in the beginning stage of practice.

Table 4. A diary episode of a participant in the beginning stage of practice

	Violinist, session 1, episode 1 ↓
Location	First page Bar 3–12
Interpretational decisions	Staccato semiquavers Contrasting dynamics
Technical issues	Tuning Fingering/bowing Playing scales in the right key
Inner techniques	Concentrating on one part Trying not to let my mind wander Concentration
Musical emotion	Carefree light joyful
Own emotion	Frustration!

With regard to the location, we can see in Table 4 that the participant was focusing on a little section (i.e., 'worked on'). If we look at the interpretational decisions and technical issues, it becomes clear that 'working on' a particular section (in the beginning stage of practice) has everything to do with mastering technical difficulties. Working on technical aspects like tuning and fingering requires a lot of concentration, as is indicated in the Inner Techniques box (i.e., 'Concentrating on one part. Trying not to let my mind wander. Concentration').

With regard to the musical emotion, Table 4 shows that the participant indicated that there were emotions present in the music. The participant was quite specific in the description of the emotions (i.e., 'Carefree, light, joyful'). If we look at the emotions described in the Own Emotion box (i.e., 'Frustration!'), it becomes clear that this emotion is related to the practice activity: the difference between musical emotion (i.e., 'Carefree, light, joyful') and own emotion (i.e., 'Frustration!') is evident. Although the participant tried to perform the musical emotions as she had experienced them while listening to her favourite recording (as indicated during the interview), the (negative) emotions related to the technical difficulties got in the way of experiencing the musical emotion.

In the diaries of all participants, episodes with the pattern illustrated in Table 4 (i.e., 'working on little sections', 'focus on mastering technical difficulties', 'practice-related emotions paramount') were found. Whereas most participants referred to the process of mastering technical difficulties as a 'necessary evil', some participants indicated that they liked this part of the practice process in particular: 'It's nice to improve your skills and be able to play more difficult things every time you practice', to quote one of them.

In sum, during the second phase in the construction process, the participants wanted to bring across how they felt about the music (based on playing through the piece or knowing the piece as played by others). However, the technical difficulties and (negative) emotions related to the practice activity seemed to overrule the experience of the musical emotions. In order to experience and perform the musical emotions, one needed to get rid of the technical difficulties first. Therefore, the main goal of this second phase seemed to be to master technical difficulties while dealing with practice-related emotions.

Table 5. Two diary episodes of participants in the final stage of practice

	Trumpeter, session 1, episode 2 ↓	Flautist, session 6, episode 2 ↓
Location	Air + Theme	'Fantasy sections'
Interpretational decisions	Air – changing character, some aspects beautiful, some aspects a little more tense. Theme – keep it simple. Dynamic contrast, leave room for embellishment later.	Contrast to lento. Portrayal of a different character/mood.
Technical issues	For both parts dynamic contrast is paramount, tempo changes, slight accels + ralls for expression. Phrasing is fairly natural.	Tone colours. Different vibrato.
Inner techniques	I tend to lose myself in the music, not really imagining anything, more a focus on the sound.	Experiment with different imaginary landscapes: – different seasons, countryside – different times of the day – imagine senselessness – no time restrictions
Musical emotion	Humorous. Idea is to be a little cheeky, but just to show off.	Great sadness Loneliness Desire
Own emotion	Have to remain calm throughout. Play with a smile.	Sadness Desperation

Phase 3: the construction of an expressive interpretation. The third phase within the construction process of an expressive performance could be illustrated by Table 5, two diary episodes of participants in the final stage of practice.

Whereas in the second phase an important aspect was to master technical difficulties, in the third phase the technique seemed to be already 'under the fingers'. This becomes clear if we have a closer look at Table 5. The locations described are 'Air + Theme' and 'Fantasy sections'. The choice to speak about 'fantasy sections' in particular indicated that the participant had already quite defined ideas about the interpretation of the piece. The interpretational decisions described also indicated a thorough knowledge of the pieces at play. Comments such as 'leave room for embellishment later' and 'portrayal of a different character/mood' pointed towards the existence of particular ideas about the interpretation of the piece.

If we look at the technical issues described, we can see a focus on technical aspects used in order to put across the desired interpretation and expression – as opposed to technical aspects such as fingering and tuning, paramount with regard to learning to play the notes of a piece. The first participant (a trumpeter) seemed to be more focused on performance directions such as dynamic contrasts, tempo changes and phrasing. The second participant (a flautist), conversely, seemed to be more focused on the creation of a particular sound, by referring to tone colour and vibrato.

Like the technical issues, the inner techniques described in the second phase seemed to be more related to finding a way to deal with the technical difficulties, whereas the inner

techniques described in the third phase seemed to be more related to the aspect of experiencing the music (e.g., 'I tend to lose myself in the music, not really imagining anything, more a focus on the sound') and bringing across the musical emotions ('Experiment with different imaginary landscapes: different seasons; countryside; different times of the day; imagine senselessness; no time restrictions'). During the interview the flautist pointed out:

> ehm ... first of all, the colours are on the page, and then I'll try the different emotions, by means of the imagination of different imaginary landscapes like I described in the diary, then I'll write on my part 'this is how you should feel', and once I recognize it more and more I can take it off the part. (Flautist)

In this quote, the notions 'this is how you should *feel*' and 'once I *recognize* it more and more' seemed to be particularly interesting: these notions suggest a transition from *feeling* the emotions into *knowing* the emotions. Although all participants indicated that at some point during the process of constructing an expressive interpretation they felt the emotions present in the music, as learning proceeded, 'feeling' the musical emotions seemed to transform into 'knowing' the musical emotions. The performer had figured out how to perform the emotions or characters s/he wanted to convey and had found appropriate musical features in order to put the desired expression across.

With regard to the musical emotion described in Table 5, the participants were quite specific in their descriptions (e.g., 'Humorous. Idea is to be a little cheeky, but just to show off' and 'Great sadness; loneliness; desire'). Interesting to note is that the own emotion seemed, especially for the flautist, to be in line with the musical emotion (i.e., Musical Emotion: 'Great sadness; loneliness; desire' and Own Emotion: 'sadness; desperation'). The own emotion described by the trumpeter seemed to be a combination of emotions related to the practice activity (i.e., 'Have to remain calm throughout') and emotions related to the music (i.e., 'Play with a smile'). During the interview he explained:

> Remaining calm is just a general thing that you have to do every time. Playing with a smile is specific to this piece, to achieve the emotion for yourself; achieve that sort of humorous effect within your own head and hopefully in the head of the audience as well. (Trumpeter)

In the diaries of all participants, episodes with the pattern illustrated in Table 5 (i.e., 'working on particular sections', 'focus on interpretation and expressivity', 'music-related emotions paramount') were found. During the interviews, several participants indicated that this phase could be very intense, as they tried to bring their own emotions in line with the musical emotions. In the words of one of them: 'Emotionally you get drained, because you are going through all these emotions. At the end of practising you can be absolutely exhausted.'

In sum, during the third phase of the construction process of an expressive performance, the interpretational concerns seemed to occupy centre stage. During this third phase, the technical difficulties were no longer that much of an issue. Therefore, the technical issues worked on and inner techniques used seemed to serve another purpose: trying to bring the own emotions in line with the musical emotions. The performers used their own feelings and experiences to construct an expressive interpretation, detailing both the interpretative decisions regarding the emotions or characters one wanted to convey, and the skills and knowledge of the appropriate musical features one needed to apply in order to play in an expressive way. As learning

proceeded, 'feeling' the musical emotions transformed into 'knowing' the musical emotions, and the intensity of felt emotions waned. The main goal of the third phase in the construction process of an expressive performance seemed to be to construct an expressive *interpretation*.

Phase 4: the construction of an expressive performance. The fourth phase within the construction process of an expressive performance could be illustrated by Table 6, a diary episode of a participant in the absolute final stage of practice.

Table 6. A diary episode of a participant in the absolute final stage of practice

	Cellist, session 5, episode 1 ↓
Location	Whole piece
Interpretational decisions	Looking at character a little. Contrasts between movements. Creating atmosphere (ones movements, where one looks, how one sits … – as well as in sound).
Technical issues	Looked at breathing towards end of session – I was holding my breath – made me tense and apprehensive about playing.
Inner techniques	I again imagined my sound/ energy going into a point of light – but only briefly – to help concentration.
Musical emotion	First movement – intense, longing, pain, distress, sadness. Second movement – mixture of optimism, aggression, pain, violence; very confident and extrovert.
Own emotion	I felt relatively calm – although I would say I was still mentally engaged with various emotions within the music.

The location described is 'whole piece', and according to the participant this episode could be seen as a 'trial performance'. If we look at the interpretational decisions and technical issues described, we can see that this participant described aspects such as 'creating atmosphere' and 'looking at breathing' (note that the participant is a string player). It seemed that these aspects were not that much related any more to playing the cello, but more to the act of performing in front of an audience. With regard to the inner techniques, the participant referred to an extensive form of imagination he used previously in order to evoke a high level of concentration: the memory of an intense imagination of a theatrical space helped him to get into the appropriate state of mind to perform the piece.

The musical emotions found to be present were well defined. As became clear from the other episodes in his diary and from the interview, the participant had experienced the described musical emotions in an intense way during practice. With regard to the own emotions described (i.e., 'I felt relatively calm – although I would say I was still mentally engaged with various emotions within the music') the notion of being 'mentally engaged with various emotions within the music' seemed to be noteworthy. During the interview the participant indicated:

> Participant: I think … it's not gonna … that intensity that maybe you found will not go away if you are not feeling it. Because it is sort of … that intensity makes the actual sound of your playing more stronger … that will hopefully stay. You don't need to feel those emotions again.

Interviewer: That's interesting. So do you think that somewhere during the practice process you really need to feel the emotions yourself, and then after a while you can, well, use them for your interpretation and express them without feeling them any more?

Participant: Yeah not feeling them. But maybe thinking them. So you are still connected to those emotions but it's not overwhelming you. … you don't necessarily have to feel these emotions when you are playing. You have to identify with them, mentally, in order to communicate something. (Cellist)

By the participants in the present study performing in an expressive way was not just seen as 'feeling the musical emotions'. During the interviews, it became clear that there was found to be a difference between 'emotional playing' and an 'expressive performance'. Whereas in the case of emotional playing one was 'just feeling and enjoying the music', in the case of an expressive performance some awareness of the act of performing was required. In the words of two of the participants:

> I suppose you take a step back. It's another thing than like being engrossed in the music and being engrossed in playing the cello … ehm … but I find that … it's better … I feel better about my playing if I am, sort of, a little bit of a distance of it. (Cellist)

> I think, when you are performing you can never reject the fact that you are actually performing. I can't imagine any way that I could get carried away too much with the emotion … I mean, you'll keep anything in check and the most important thing is being focused and being able to play the piece well. (Trumpeter)

However, being (mentally) engaged with the emotions found to be present in the music was seen as a requirement for making an expressive performance out of the previously constructed interpretation. Some participants spoke about 'adding some felt emotion again' or 'switching on the emotion' at the point of performance; others indicated that they felt like 'being submersed in the music' during a good performance. In the words of one of them:

> You are kind of in the music. You are sort of submersed in the music, so you are not really listening to it in the same way as the audience might be listening to it as a whole. You are thinking about what you are playing at the moment and what's coming up. But then … you are just literally … just feeling the music. There's nothing else in your head than what you are playing, and making it sound the way that it should sound. (Pianist)

Taking these aspects together, it seemed that the participants defined an expressive performance (the fourth phase in the construction process) as an expressive interpretation (i.e., their interpretation of the music combined with the knowledge of how to perform the musical emotions in a convincing way) plus some felt emotion, while keeping a sense of awareness or control of what was going on.

It is important to note that the 'four phases' as described above were, to a certain extent, found to be present in the accounts of all the participants – regardless of the stage of practice they were at. The difference between the participants in the beginning stage of practice and the participants in the final stage of practice seemed to be *the extent* to which they were able to

master technical difficulties, to translate their interpretation into expressive music and 'to take a step back' and give a performance rather than being too much concerned with technical or interpretative issues. The finding that the four phases were found to be present in the accounts of all the participants seemed to suggest that the construction process of an expressive performance is more circular than linear. In other words, an expressive performance did not seem to be something definite: after only a week of practice at least the third phase was reached while performing in front of a music teacher, and after having given a concert; for the next performance the subsequent phases needed to be reiterated again. This could be explored in future, studied by longitudinal studies where the evolution of a performance over time is tracked within individual performers.

Discussion

The present study aimed to investigate what role a performer's experienced emotions might play in the construction of a musically expressive performance. The questions proposed in the introduction were explored through qualitative in-depth interviews based on recent practice experiences monitored by means of an Individual Playing Diary.

The present research provided some preliminary insights. The findings suggested that a distinction needed to be made between emotions found to be present in the music (or perceived emotions) and own emotions (or felt or induced emotions) – as was proposed by Gabrielsson (2001–02, p. 138). In addition, the own emotions seemed to be divided into practice-related emotions (e.g., frustration at not being able to master technical difficulties) and music-related emotions (e.g., aesthetic delight) – a distinction that might correspond to the distinction between utilitarian and aesthetic emotions as proposed by Scherer and Zentner (2008). Moreover, the role of a performer's experienced emotions seemed to change during the process of constructing an expressive performance. There seemed to be a progression within the construction process of an expressive performance. This progression was characterized by four phases. During the first phase, the participants seemed to use their own (music-related) emotions in order to explore how they 'felt the piece should sound'. During the second phase, practice-related emotions prevailed while the participants tried to master technical difficulties. During the third phase, the participants seemed to use their own (music-related) emotions in order to find the best way of portraying a certain emotion found to be present in the music. Interestingly, as learning proceeded, 'feeling' the musical emotions seemed to transform into 'knowing' the musical emotions, and the intensity of felt emotions waned. During the fourth phase, the expressive interpretation was brought into play while adding some felt emotion and keeping a sense of awareness of what was going on. Although the division into phases differs from Chaffin's et al. categorization, the findings of the present study seem to confirm the presence of subsequent stages of practice as identified by Chaffin et al. (2002). In addition, the findings of the present study suggest that performer's experienced (music-related) emotions play a role especially regarding the decisions made in relation to 'interpretative cues' and 'expressive cues' as identified by Chaffin et al. (2002, 2006).

There was found to be a difference between 'emotional playing' and an 'expressive performance'. Emotional playing was described as 'just feeling and enjoying the music' and seemed to be primarily present during the first and third phase within the construction process. An expressive performance seemed to include a sense of awareness of the act of performing while being (mentally) engaged with the emotions found to be present in the music. In the case of an

expressive performance, the conveyance of the previously constructed interpretation towards an audience seemed to take centre stage – rather than the performer's own emotional experience. This finding seems to add to the findings by Lindström et al. (2003).

All participants in the present study indicated that their interpretation of a piece of music was mainly based on their feelings (i.e., 'how they felt it should sound') by playing it through. In addition to their feelings, the participants indicated that the composer's intended and prescribed intentions (as present in the score) needed to be followed, and conventions regarding musical structure and style needed to be taken into account as well. Although all participants considered their feelings to be the most important aspect to base their interpretation on, where their feelings did not fit with the performance directions or musical conventions, the participants found that they had to compromise their feelings. This finding seems to be in line with the findings of previous research (e.g., Juslin, 2001; Persson, 1993).

An interesting finding was that no less than 12 different forms of 'inner techniques' were used by the participants. The four inner techniques described by most participants were: imagination (i.e., metaphor, visualization, character); focus on sound/tone colour; concentration/focus in general; and body movement. These findings add to the findings of previous research (e.g., Persson, 2001; Schippers, 2006; Woody, 2002). The effect the use of certain inner techniques could have on the acoustic features and expressivity (rating) of a performance seems to be an interesting topic requiring further research.

Of particular interest were some findings regarding the Musical Emotion and Own Emotion boxes of the Individual Playing Diary. Whereas the musical emotions described seemed to reflect upon the characteristics of the music in all its subtlety, regarding the own emotions – and especially the own emotions related to the practice activity – characterizations such as 'sad', 'calm' and 'tense' seemed to be precise enough in order to describe the emotion at play. Future research is needed to further investigate the difference in descriptions found regarding musical and own emotions.

Performing musicians have to face the question of how to best achieve an expressive performance. Should the performance be based on their own emotional experience of the music being played? Or should they rather rely on the technical use of appropriate musical means – such as tempo, volume, articulation, timbre? The present research revealed that emotional engagement seems to be central during the process of constructing an expressive performance – at least in case of the music students who took part in this study. Appropriate musical means were used and conventions regarding musical structure and style were followed. None of the performers studied constructed a performance without any reference to their own emotions, however. The way the music students engaged their emotions was complex and changed over the duration of the practice period. Future research would need to test the generality of these findings on a larger and more diverse sample. The findings of the present research seem to be a preliminary pointer to an under-studied phenomenon that deserves more attention if we are to gain a fuller understanding of music performance as a creative practice.

Acknowledgements

The authors would like to thank the musicians studying at the Royal Northern College of Music and Keele University who were willing to share their knowledge, experience and feelings concerning the preparation of a musically expressive performance. The first author was supported by the Academy of Finland (project number 7118616).

Notes

1. As could be seen in Table 1, some participants reported about their practice on a piece of music with piano or orchestra accompaniment. During the interviews it was asked whether the participants thought the (lack of) accompaniment during practice was considered to be of any major influence on how they constructed their interpretation. According to the participants, this was not the case. However, some of the participants indicated that sometimes they had to change their interpretation a bit once they started to play together with a pianist or orchestra.
2. Not all the participants returned the preliminary and concluding sheets of the diary. Therefore, only the Individual Playing Sheets are discussed.
3. Due to space constraints, only the results of the constructionist analysis are presented here at length. For a detailed account of the quantitative content analysis of the diaries and qualitative thematic analysis of the interview transcripts, see Van Zijl (2008).
4. All participants indicated that they initially based their interpretation on their 'feelings', on 'how they felt the music should sound'. In this regard, all participants used the verb 'to feel'. For an interesting explanation of this tendency, see Reimer (2004). Although concepts like 'music-related emotions' or 'musical intuition' might, perhaps, be more accurate to describe the process on which the participants based their interpretation, it was decided not to change the words chosen by the participants.

References

Chaffin. R., Imreh, G., & Crawford, M. (2002). *Practicing perfection: Memory and piano performance*. Mahwah, NJ, London: Lawrence Erlbaum Associates.

Chaffin, R., Lemieux, A. F., & Chen, C. (2006). Spontaneity and creativity in highly practiced performance. In I. Deliège & G. A. Wiggins (Eds.), *Musical creativity: Multidisciplinary research in theory and practice* (pp. 200–218). Hove and New York: Psychology Press.

Gabrielsson, A. (2001–02). Emotion perceived and emotion felt: Same or different? *Musicae Scientiae* [Special issue], 123–147.

Juslin, P. N. (2001). Communicating emotion in music performance: A review and theoretical framework. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 431–449). Oxford: Oxford University Press.

Juslin, P. N. (2003). Five facets of musical expression: A psychologist's perspective on music performance. *Psychology of Music*, *31*(3), 273–302.

Lindström, E., Juslin, P. N., Bresin, R., & Williamon, A. (2003). 'Expressivity comes from within your soul': A questionnaire study of music students' perspectives on expressivity. *Research Studies in Music Education*, *20*, 23–47.

Persson, R. S. (1993). The subjectivity of musical performance: An exploratory music-psychological real world enquiry into the determinants and education of musical reality. Unpublished doctoral dissertation, Huddersfield University, UK.

Persson, R. S. (2001). The subjective world of the performer. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion. theory and research* (pp. 275–289). Oxford: Oxford University Press.

Persson, R. S., Pratt, G., & Robson, C. (1992). Motivational and influential components of musical performance: A qualitative analysis. *European Journal for High Ability*, *3*, 206–217.

Reimer, B. (2004). Once more with feeling. Reconciling discrepant accounts of musical affect. *Philosophy of Music Education Review*, *12*, 4–16.

Scherer, K. R., & Zentner, M. R. (2008). Music evoked emotions are different – more often aesthetic than utilitarian. *Behavioral and Brain Sciences*, *31*, 595–596.

Schippers, H. (2006). 'As if a little bird is sitting on your finger …': Metaphor as a key instrument in training professional musicians. *International Journal of Music Education*, *24* (3), 209–217.

Seale, C. (2004a). Generating grounded theory. In C. Seale (Ed.), *Researching society and culture* (2nd ed.) (pp. 239–248). London: Sage.

Seale, C. (2004b). Coding and analysing data. In C. Seale (Ed.), *Researching society and culture* (2nd ed.) (pp. 305–323). London: Sage.

Sloboda, J. A. (1999). Musical performance and emotion: Issues and developments. Reprinted in Sloboda, J. A. (2005), *Exploring the musical mind* (pp. 225–240). Oxford: Oxford University Press.

Sloboda, J. A., & Lehmann, A. C. (2001). Tracking performance correlates of changes in perceived intensity of emotion during different interpretations of a Chopin piano prelude. *Music Perception*, *19*(1), 87–120.

Tonkiss, F. (2004). Analysing text and speech: Content and discourse analysis. In C. Seale (Ed.), *Researching society and culture* (2nd ed.) (pp. 367–382). London: Sage.

Van Zijl, A. G. W. (2008). The role of the performer's experienced emotion in the construction of a musically expressive performance. Unpublished master's dissertation, Keele University, UK.

Walsh, D. (2000). Doing ethnography. In C. Seale (Ed.), *Researching society and culture* (pp. 217–232). London: Sage.

Woody, R. H. (2000). Learning expressivity in music performance: An exploratory study. *Research Studies in Music Education*, *14*(1), 14–23.

Woody, R. H. (2002). Emotion, imagery and metaphor in the acquisition of musical performance skill. *Music Education Research*, *4*(2), 213–224.

Anemone G. W. Van Zijl has a background in Arts and Social Sciences (BA and MPhil at Maastricht University, The Netherlands) and Music Psychology (MSc at Keele University, UK). Since 2009 she has been a doctoral student within the Finnish Centre of Excellence in Interdisciplinary Music Research, University of Jyväskylä, Finland. Her research focuses on the relationship between performers' experienced emotions and the expressivity of the produced performances. Anemone plays the oboe and cor anglais in several orchestras.
Address: Finnish Centre of Excellence in Interdisciplinary Music Research, Music Department, University of Jyväskylä, PO box 35(M), 40014 Jyväskylä, Finland. [email: anemone.vanzijl@jyu.fi]

John Sloboda is Emeritus Professor of Psychology at Keele University, UK, where he founded and led its Music Psychology programme until 2008. Since 2009 he has been Visiting Research Fellow at the Guildhall School of Music and Drama, London. His research interests have spanned cognition, emotion, ability, and functional aspects of music engagement. He is currently convening a research initiative on interactions between composers, performers, and their audiences. He has been Editor of *Psychology of Music* (1986–90), President of the European Society for the Cognitive Sciences of Music (1995–98), and in 2004 was elected to Fellowship of the British Academy.
Address: Guildhall School of Music & Drama, Silk Street, Barbican, London EC2Y 8DT, UK. [email: j.a.sloboda@psy.keele.ac.uk; john.sloboda@gsmd.ac.uk]

Appendix A. Interview Guide for first interview

- Introduction
  - Explain the procedure of the research; opportunity for the participant to ask any questions
  - Let the participant sign the consent form
  - Collect some demographic info (gender; age; instrument(s); years of playing; began to play at age; years of performing live individually; years of performing live in ensemble; average hours of practice per week; conservatoire or university student and year of study)
- Classification into 'beginning stage of practice group' or 'final stage of practice group'
  - Which piece of music does the participant intend to describe?
  - How long has the participant already been working on the piece?
- Ask some topic-related questions
  - What are the reasons for studying the particular composition (i.e., the participant wants to play this piece; advice of the music teacher; an upcoming performance; ...)?
  - Has the participant given any performances of the piece before (in a concert situation; during a master class; during a music lesson; ...)?
  - What is the participant's 'emotional relationship' to the piece?/Does s/he have any particular emotions/associations/memories/... to the piece? (e.g., a memory of the first time s/he heard the piece)
  - How would the participant describe an expressive performance?/Could the participant list some characteristics?
  - How would the participant describe 'emotional playing' and an 'expressive performance'?
- Explain the use of the Individual Playing Diary
- Make an appointment for the second interview

Appendix B. Individual Playing Diary sheet

Individual Playing Diary Sheet *(double sided)* *(please complete one diary for each session in which you play or practice your chosen piece)*

Date of playing session _____ Time session started _____ Time spent on playing/ practicing your chosen piece _____

Try to list the activities in order that they occurred in the session

Location	Interpretation	Technical Issues	Inner Techniques	Musical Emotion	Your Own Emotion
Describe the section of the music you were playing/ working on *(e.g., page; bars; line; passage; whole piece; playing through; …)*	Describe your interpretational decisions with regard to the musical expressivity you wanted to bring to the fore (if any) at this location *(e.g., particular character; particular contrast; building up or release of tension; …)*	Describe the technical aspects you used/worked on in particular (if any) in order to perform the desired interpretation/ expressivity *(e.g., phrasing; tempo; timing; dynamics; articulation; timbre; vibrato; bowing; finger technique; breathing; …)*	Describe the 'inner techniques' you used (if any) in order to perform the desired interpretation/ expressivity *(e.g., think about something in particular (if so, please indicate about what you were thinking); imagination of something visual or audible (please indicate what you imagined); tried to get yourself in a particular mood (please indicate what mood and how you tried to achieve this); …)*	Describe the emotion present in the music (if any) at this location *(e.g., happiness; joy; love; desire; surprise; humour; calm; tension; sadness; anger; fear; pain; loneliness; nostalgia; …)*	Describe your own emotions involved (if any) during your playing of the indicated section *(e.g., happiness; joy; love; desire; surprise; humour; calm; tension; sadness; anger; fear; pain; loneliness; nostalgia; frustration; …)*
1)					
2) …					
8)					

Comments: Please write here any general comments about the overall session, for instance about its aims, and the extent to which you felt it achieved its aims:

Appendix C. Interview Guide for second interview

- Introduction
  - Explain the procedure of the second interview.
  - How did the participant find it to fill out the Individual Playing Diary?
  - Has the participant experienced any problems with the Diary?
- Ask specific questions based on the discrete practice activities described in the Individual Playing Diary. These questions are different in each interview. However, while asking the participant to explain or elaborate upon aspects described in the diary, the following questions are in the mind of the researcher:
  - By means of what 'strategies' does the participant construct an expressive performance? (e.g., based on emotion/physical feeling; intellectual considerations; musical structure; …)
  - How do the particular technical aspects/practice activities used (if mentioned in the diary) relate to the interpretational/expressive decisions made, and to the mentioned emotions both in the music and in the participant?
  - Could the participant elaborate upon the kinds of 'inner techniques' used (if mentioned in the diary) in order to construct/perform an expressive performance? (e.g., inner techniques like mood induction; visualisation; thoughts; imitation; …)
- Ask some general questions (if not already covered during the discussion of the Individual Playing Diary)
  - How do the felt emotions of the participant relate to the perceived emotions in the music/the performed emotion?
  - According to the participant, what is the role of emotion in constructing an expressive performance?
  - Does the participant think s/he would have felt different/would have filled in the diary in a different way if s/he had to write about another piece?
  - Is it, according to the participant, possible to construct an expressive performance without ever having any emotional reactions to the piece being played?
  - Did the experience of filling in the diary influence the participant's ideas concerning the role of emotions regarding the construction of an expressive performance?
  - After the experience of filling in the diary, how would the participant describe 'emotional playing' and an 'expressive performance'?
- Ask the participant if there is anything s/he would like to add or ask

II

MOVED THROUGH MUSIC: THE EFFECT OF EXPERIENCED EMOTIONS ON PERFORMERS' MOVEMENT CHARACTERISTICS

by

Anemone G. W. Van Zijl & Geoff Luck, 2012

Psychology of Music 41(2), 175-197

sempre:
Society for Education, Music and Psychology Research

Article

Psychology of Music
41(2) 175–197

DOI: 10.1177/0305735612458334
pom.sagepub.com
SAGE

Moved through music: The effect of experienced emotions on performers' movement characteristics

Anemone G.W. Van Zijl and Geoff Luck
Finnish Centre of Excellence in Interdisciplinary Music Research, University of Jyväskylä, Finland

Abstract

Do performers who feel sad move differently compared to those who express sadness? Although performers' expressive movements have been widely studied, little is known about how performers' experienced emotions affect such movements. To investigate this, we made 72 motion-capture recordings of eight violinists playing a melodic phrase in response to three different instructions. The first instruction was to focus on the technical aspects of playing. The second instruction was to give an expressive performance. Before the third instruction, performers were subjected to a mood induction task. Following this, performers played while focusing on their experienced emotions. After each playing condition, performers were interviewed about their thoughts and feelings. Analyses of the amount, speed, acceleration, and smoothness of movement revealed a different pattern of movement characteristics for each performance condition. In the expressive condition, the amount, speed, acceleration, and jerk of movement were highest. In the emotional condition, performers moved less, slower, and more smoothly. The findings of this exploratory study provide concrete evidence that performers' experienced emotions affect the movement characteristics of their performance.

Keywords

body movement, emotional performance, expressive performance, felt emotion, motion capture, performing musicians

Sometimes a performance is perfect: the notes are correct, the rendition is valid, the use of vibrato is appropriate, and it sounds expressive. Still, there seems to be something missing. Is it a certain sensitivity? Spontaneity? Emotional engagement? Inspiration? As a listener, one is not moved by the performance.

One could assume that this has everything to do with the listener, that the listener's expectations, memories and associations, mood, personality, experiences, and environmental circumstances determine the emotional impact a performance has (e.g., Juslin & Västfjäll, 2008;

Corresponding author:
Anemone G. W. Van Zijl, Finnish Centre of Excellence in Interdisciplinary Music Research, University of Jyväskylä, PO Box 35(M), 40014, Jyväskylä, Finland.
Email: anemone.vanzijl@jyu.fi

Vuoskoski & Eerola, 2011; Zentner, Grandjean & Scherer, 2008). However, the listener's perspective might not reveal the complete story. Often, many listeners agree about the special nature of a performance. Moreover, several researchers point towards the elusive feature that turns a technically perfect performance into a remarkable one (e.g., Altenmuller & Schneider, 2009; Chaffin, Lemieux & Chen, 2007; Hallam, 1995; Juslin, 2001, 2009; Reid, 2001; Sloboda, 1996; Sloboda, Minassion & Gayford, 2003). What could this feature be? Could it be the experienced emotions of the performer, and the effect the performer's emotions might have on the characteristics of their performance, that turn a perfect performance into a remarkable one?

The present study is part of a larger project in which we aim to investigate the relationship between performers' experienced emotions and the expressivity of their performances. To our knowledge, only two studies addressing the effect of performers' experienced emotions on their performances have been previously published. Higuchi, Fornari, and Leite (2010) subjected nine pianists to a mood induction procedure before they performed a piece for four hands by Robert Schumann – with the main researcher as co-performer – once while focusing on each note, and once while thinking of the emotional stimuli. Analyses of the audio recordings revealed that participants played more *legato* and with less metric precision in the emotional playing condition. Glowinsky et al. (2008) subjected two violinists to a mood induction procedure prior to their performance of several pieces by J. S. Bach in an angry, sad, joyful, and peaceful manner. Analyses of the audio, video, and physiological recordings revealed differences in duration time of the performances, differences in heart rate, galvanic skin response, and tension in the right arm. The authors did not specify these differences in relation to the performance conditions, nor did they explain any patterns in their data.

In the present article, we explore the effect of performers' experienced emotions on the movement characteristics of their performances. Research indicates that movement characteristics and visual aspects are very important for the experience and judgement of a performance by an audience (e.g., Armontraut, Schutz & Kubovy, 2009; Davidson, 1993; Juchniewicz, 2008; Schutz, 2008). In a pioneering study, Davidson (1993) found that there is sufficient perceptual information contained in performers' kinematics to permit the identification of so-called "deadpan," "projected," or "exaggerated" performances. Other studies support this and show that performers, when asked to perform with different levels of expressivity, tend to move more when playing more expressively (e.g., Sakata et al., 2009; Thompson & Luck, 2008, 2012). In a recent study, Thompson and Luck (2012) investigated the kinematic characteristics exhibited in "normal," "deadpan," "exaggerated," and "immobile" performances of pianists. They examined the amount of movement, as well as velocity and acceleration contours, of different body parts (i.e., the hip centre, mid-torso, neck, head centre, left and right shoulder, elbow, wrist, and middle finger) across performance conditions. They found that the head and shoulders exhibited more movement, as well as larger differences between performance conditions, than the fingers, wrists, and lower back. They suggest that these differences arise from biomechanical factors related to playing the piano, and performers equating playing without expression to playing without non-essential movements. Non-essential movements, also referred to as ancillary movements or performance gestures, have been studied increasingly as well (e.g., Davidson, 2001; Davidson et al., 2002; Wanderley, 1999, 2002; Wanderley, Vines, Middleton, McKay, & Hatch, 2005). Wanderley et al. (2005), for instance, looked at clarinettists' ancillary gestures when performing in a so-called "standard," "expressive," or "immobilized" manner. They found that performers' ancillary gestures were consistent across performances, but differed in amplitude. Some performers displayed a tendency to express ancillary movements in their knees, while others used mainly waist-bending gestures, moved

their head up and down, or moved their clarinet. The influence of performers' experienced emotions on the movement characteristics of their performances, however, has yet to be examined.

We are particularly interested in whether a performer moves differently when feeling musical emotions as compared to when expressing musical emotions. The assumption that felt and portrayed emotions result in similar expressions has been debated in relation to vocal, facial and bodily expressions (e.g., Bachorowski & Owren, 2003; Crane & Gross, 2007; Banse & Scherer, 1996; Wallbott, 1998; Zuckerman, Hall, DeFrank, & Rosenthal, 1976). Although the debate has yet to be resolved, there is some evidence that emotions portrayed by actors and emotions induced in participants result in similar bodily expressions. Wallbott (1998), for instance, in a study investigating the specificity of body movements and postures for certain emotions, asked actors to portray 14 emotions (such as "elated joy," "happiness," "sadness," "despair," and "fear") and coded the positions of the upper body, as well as the quality of the movements in terms of activity, expansiveness, and energy. In the case of the portrayal of sadness, he found that actors chose a collapsed body posture, and that their movements scored low in terms of activity, expansiveness, and energy. Crane and Gross (2007) used an autobiographical memory paradigm to elicit four different emotions ("anger," "sadness," "contentment," and "joy") in students before investigating their gait characteristics in terms of kinematic features. They found that sadness was characterized by a slower speed, lower amplitude of upper extremity motion, lower range of motion in the shoulders, elbows and hips, and a downward orientation of the head and upper body. The issue of whether felt and portrayed emotions of musicians result in similar performance expressions remains unclear.

In several studies, emotional and expressive playing are considered as being one and the same (e.g., Karlsson & Juslin, 2008; Woody, 2000). Van Zijl and Sloboda (2011), however, found that music students described "emotional playing" as "just feeling and enjoying the music." In the case of an expressive performance, the communication of a previously constructed musical interpretation to an audience seemed to take centre stage, rather than the performer's own emotional experience. In the present study, we aimed to explore whether a performer moves differently when feeling musical emotions compared to when expressing musical emotions.

To investigate whether we could distinguish between expressive and emotional playing based on performers' movements, we conducted an experimental study in which we asked performers to play a melodic phrase in response to three different instructions. The first instruction was to focus on the technical aspects of playing. By this we meant aspects such as rhythm, dynamics, and articulation.[1] The second instruction was to give an expressive performance. An expressive performance can be defined in many different ways (e.g., Juslin, 2003, 2009; Lindström, Juslin, Bresin, & Williamon, 2003; Sloboda, 1996, 2000; Timmers & Honing, 2002). In the present study, we left it intentionally open as to what we mean by an expressive performance. We simply asked participants "to give an expressive performance as they would normally do" without any further explanation. Following a mood induction procedure, the third instruction was to play while focusing on experienced emotions. We defined experienced emotions as music-related felt or induced emotions of the performer, as opposed to practice- or performance-related emotions (see Van Zijl & Sloboda, 2011) or perceived emotions (see Gabrielsson, 2001–2002). After each playing condition, performers were interviewed about their thoughts and feelings concerning their performances.

In our study, we focused on sadness. To increase the ecological validity of the research, we chose mood induction techniques that are in line with methods musicians tend to use when

constructing an interpretation and preparing for a performance (e.g., Juslin, 2003; Persson, 2001; Persson, Pratt, & Robson, 1992; Van Zijl, 2008). In addition, we chose a musical phrase that, based on its structural features, can be characterized as sad.

Inspired by the literature, we investigated the amount, speed, acceleration, and smoothness of movements overall, and for different body parts (e.g., Thompson & Luck, 2012; Wanderley et al., 2005), examined changes in body posture (e.g., Crane & Gross, 2007; Wallbott, 1998), and explored the effect of performance length/playing tempo on the movement characteristics investigated (e.g., Thompson & Luck, 2012; Wanderley et al., 2005). More specifically, we were guided by the following questions: (1) Can we find differences in body posture between performance conditions, as indicated by changes in angle of body segments? (2) Can we find differences in amount, speed, acceleration, and smoothness of movement between performance conditions, as indicated by the total distance travelled, speed, acceleration, and jerk of the movements made? (3) What effect do differences in performance length/playing tempo have on these characteristics?

Method

Participants

Participants were eight violinists (all female, mean age 24.3 years, SD = 1.8). Four of them were professional musicians, recently graduated from a conservatoire in Finland. The other four were accomplished amateur musicians studying at a university in Finland.[2] Both groups were identical in terms of gender, and similar in terms of age and years of playing. They differed in terms of years of lessons, practice hours per week, and number of performances per year. Table 1 gives an overview of the musical background of the participants.

Musical stimuli

One week prior to data collection, participants received the sheet music of two musical phrases. The phrases were taken from *Three miniatures for oboe and piano: Orientale, Chansonette, A la campagne* by the British composer Sir Hamilton Harty (1911). The first 14-bar phrase was taken from the movement *Orientale*. This phrase is in G minor, and the tempo indication is *Lento ma non troppo*. On these bases, we characterized this phrase as sad and atmospheric. The second 18-bar phrase was taken from the movement *Chansonette*. This phrase is in A major, and the tempo indication is *Grazioso e con moto*. On these bases, we characterized this phrase as happy and dance-like. Only the solo parts were used, not the piano accompaniment. Two violinists

Table 1. Musical background of the participants

	Amateurs		Professionals	
	Mean	Standard deviation	Mean	Standard deviation
Age	24.8	2.06	23.8	1.71
Years of playing	17.8	2.63	18	2.16
Years of lessons	12.5	5.97	17.3	2.63
Hours of practice per week	3.8	4.35	19.5	6.14
Performances per year	10.8	6.24	38.5	7.68

tested the phrases beforehand to make sure they were suitable for being played on a violin. The phrases were chosen because of their unfamiliarity, contrasting characters, and limited difficulty. For the experiment, the composer and title of the piece were removed from the score. In the present article, we focus on the first ("sad") phrase. The second ("happy") phrase was mainly included because of ethical considerations: to help ensure that participants were in a positive mood at the end of the data collection procedure (see below).

Apparatus

An eight-camera optical motion-capture system (Qualisys ProReflex) with a sample rate of 120 frames per second was used to record the 3-dimensional position data of 33 reflective markers attached to the body and instrument of each participant. Figure 1(a) shows the placement of the reflective markers. Audio recordings were made using ProTools8 software (manufacturer: Avid) and a Microtech Gefell M300 directional microphone surrounded by an SE Electronics Reflection Filter. For reference purposes, video recordings were made with four Sony video cameras.

Materials and Procedure

Prior to data collection, participants completed the Positive and Negative Affect Scale (PANAS) state questionnaire (Watson, Clark & Tellegen, 1988) to assess their current mood. After participants had warmed up, the first recording session began. Participants were asked to play the first phrase according to the following instruction: "Try to focus on the technical aspects of your playing: think for instance about the rhythm, think about the dynamics, and think

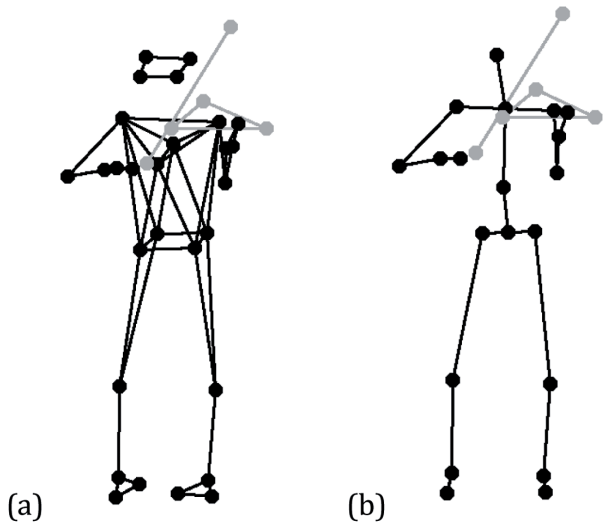

Figure 1. (a) Placement of the markers attached to the participant's body and instrument; (b) Reduced marker set-up as used in the movement analyses

about the articulation." Participants were encouraged to play the phrase as many times as they liked, and take as much time as needed to prepare themselves. This usually resulted in three performances per recording session.[3] Following the first recording session, participants were interviewed about their performances. They were asked which performance was most representative in light of the instruction given; what they thought about while playing; whether it felt natural to them to play while thinking about the instruction; and how they felt while playing.

When the participant was ready to move on, the second recording session began. This time the instruction was: "Play as you would normally play while giving an expressive performance." Again, participants were encouraged to play the phrase as many times as they liked, and to take as much time as needed to prepare themselves. Subsequently, the same questions as above were asked.

Before the third recording session, participants were subjected to a two-part mood induction task. They were told that the first phrase was taken from a piece of music written by a British composer in 1911. The composer was married and had a 4-year-old son. Participants were asked to imagine the following scene:

> It's about 8 o'clock in the evening. The composer has just brought his little son to bed. Normally his little boy always wanted to hear a story. But this time it was different. This time the boy looked pale, he didn't seem to feel well, and he didn't want to hear a story. He was just afraid to be left alone. The composer was worried about him. Soon the little boy felt asleep, but he was trembling, and dreaming heavily. As soon as his wife arrived, the composer went away to call for the doctor. Finally the doctor arrived. But it was already too late. The little boy had died in the arms of his mum.

Participants were told that the first phrase was written shortly after the composer lost his son, and that he might have tried to express his sadness in the music. This task was inspired by literature indicating that, when preparing a performance, musicians tend to collect background information about the composer, his/her intentions, and the period in which the piece of music was written (e.g., Juslin, 2003; Van Zijl, 2008). In addition, participants were asked to think of an intensely sad experience during which they felt emotions similar to the grief and sadness of the composer. They were encouraged to imagine their experience as vividly as possible, and try to feel again how they felt during their experience. Participants either wrote a few lines about their experience, or told the experimenter about it.[4] This task was inspired by literature reporting that musicians tend to recall emotional memories or memories of emotions to bring themselves into an appropriate mood to play a certain piece (e.g., Persson, 2001; Persson et al., 1992). Subsequently, participants were asked to play the first phrase according to the following instruction: "Think about the emotional experience you've just written/spoken about. Try to feel the emotions of grief, of great sadness expressed by the music. Don't think about your playing, just focus on the emotions."

After the third recording session, participants completed the PANAS state questionnaire again to assess whether their mood had changed. In addition to the questionnaire, participants were asked whether the story about the music and the emotional experience they thought about had changed the way they felt. Then, the same interview questions as above were asked.

After participants had completed a questionnaire about their musical background and preparation of the musical phrases,[5] they were debriefed: The composer of the music did not have a son, he was just happily married. To help put the participants into a happy mood again, they completed a final recording session in which they played the second ('happy') phrase.

When the final recording session was finished, some reflective questions were asked about the entire experiment. Participants were asked what they thought about the experiment; what they thought about any differences between their performances; what their best recording session was (i.e., in relation to which instruction) and why; and whether there was anything they wanted to add or ask. Finally, the reflective markers were removed, participants received two free tickets to see a film, and they were thanked for their participation. In total, data collection lasted about 90 minutes per participant.

Movement feature extraction

Using the MATLAB Motion Capture (MoCap) Toolbox (Toiviainen & Burger, 2010), the number of markers was reduced from 33 to 25 (see Figure 1(b)),[6] and total distance travelled, speed, acceleration, and jerk were estimated from the position data of the reduced marker set-up.

Total distance travelled was estimated by summing the changes in position of each marker, and served as a measure of overall amount of movement. Speed was estimated by calculating the first time derivative of the position data. Acceleration was estimated by calculating the second time derivative of the position data. Jerk (the regularity of acceleration) was estimated by calculating the third time derivative of the position data, and served as a measure of smoothness of movement.[7]

Results

Our intention was to analyse 72 performances (8 participants × 3 performance conditions × 3 performances). However, one participant only gave two performances per performance condition. Since we excluded the extra performances of two participants,[8] 69 performances remained for analysis. We investigated the differences between performance conditions for 25 locations – including the movements of the body, violin, and bow[9] – across all participants, as well as between amateurs and professionals.

Differences in body posture, amount, speed, acceleration, and smoothness of movement were analysed via one-way repeated-measures ANOVAs and post-hoc pair-wise comparisons with Bonferroni correction for multiple comparisons. Differences between amateurs and professionals were analysed via independent *t*-tests. The differences identified both between performance conditions and between amateurs and professionals, might be related to the playing tempo. The influence of performance length on the above movement features was examined via simple linear regression analyses with performance length as predictor variable, and amount, speed, acceleration, and jerk of movement, respectively, as outcome variables.

We start by discussing the effectiveness of the mood induction procedure. Then, we address the differences in body posture between different playing conditions. Next, we report the differences in performance length. Subsequently, we present the findings concerning amount, speed, acceleration, and smoothness of movement. For each movement feature, we report the main pattern found across participants, differences found across amateur and professional players, and the influence of performance length on the findings.

Effectiveness of the mood induction procedure

The sample size of only eight participants was too small to conduct meaningful statistical analyses on the PANAS questionnaire data collected before and after the mood induction procedure.

Nevertheless, five out of eight participants showed a decrease in their positive PANAS score, and five out of eight participants showed an increase in their negative PANAS score when comparing the pre and post measurements.[10] In addition, in the interviews, all participants indicated that the mood induction procedure made them feel sad. Interestingly, however, this was not necessarily seen as something negative. In the words of one participant: "now I had something to tell through the music, not just the notes." In the words of another:

> My feelings changed into the sad direction. Being sad. But they also changed to the positive, because afterwards I got like … the feelings came closer to me, every feeling. So through this sad experience, sad emotion, also my good feelings came to the top more. […] Now I got more exhausted and more enthusiastic, and eager to play. Especially in the beginning, when I started this third session I felt really good and I loved playing. I knew again why I play, why I'm playing the violin. It felt good.

In sum, the mood induction procedure seemed to work well. However, it seems to be important to acknowledge the special characteristic of music-related emotions: experiencing sad emotions and expressing them through music can be viewed as something positive.

Body posture

We investigated the position of the body (torso) by looking at changes in y-angle of the root-to-neck-segment (see Figure 2), accounting for artefacts of twisting by the performer (Toiviainen & Burger, 2010, p. 63). If the angle was (close to) zero, the participant was standing upright. If the angle was positive, the participant was bending backwards. If the angle was negative, the participant was bending forwards. Participants were standing most upright in the Expressive condition (M = 0.54°, SD = 4.32), bent slightly backwards in the Technical condition (M = 0.69°, SD = 4.54), and bent further back in the Emotional condition (M = 2.11°, SD = 4.20). The main effect of performance condition on body posture was significant, F(1.536,

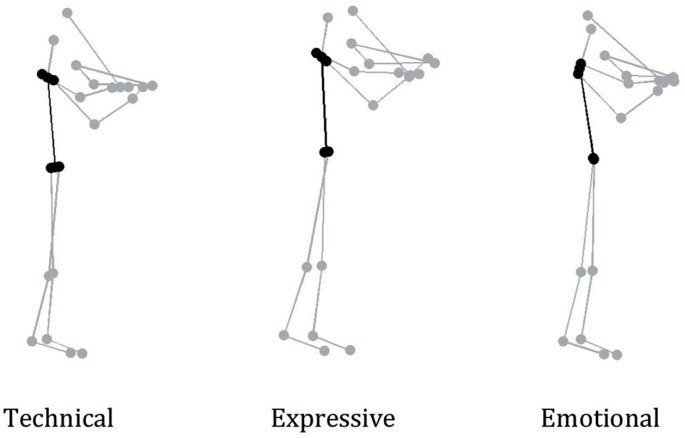

Figure 2. The position of the torso of one participant at the very beginning of each playing condition. The root-to-neck-segment is highlighted

32.260) = 4.837, $p < .05$. Post-hoc pair-wise comparisons revealed a significant difference in body posture between the Expressive and Emotional conditions only ($p < .05$). No significant difference in body posture was found between amateurs and professionals, $t(57.183) = -1.238$, $p > .05$.

Examination of the video recordings confirmed that an angle closer to zero (or a negative value) of the root-to-neck-segment was related to an erected body posture (i.e., the chest pushed forward) whereas a more positive angle of the root-to-neck-segment was related to a compressed body posture (i.e., sunken chest). Figure 2 shows the position of the torso of the same participant at the very beginning of each playing condition, indicating that the focus of attention had an immediate effect on body posture.

Performance length

The average length of performances was shortest in the Expressive condition ($M = 46.95$ sec, SD = 11.78), longest in the Emotional condition ($M = 51.90$ sec, SD = 9.75) and in between in the Technical condition ($M = 48.22$, SD = 10.49). The main effect of performance condition on performance length was significant, $F(1.544, 32.426) = 14.652$, $p < .001$. Post-hoc pair-wise comparisons revealed significant differences in performance length between the Technical and Emotional conditions ($p < .01$), and the Expressive and Emotional conditions ($p < .001$) only. The performances of the professionals ($M = 42.73$, SD = 7.93) were much shorter than the performances of the amateurs ($M = 54.46$, SD = 10.03), $t(68.992) = 5.533$, $p < .001$.

Amount of movement

The average amount of movement was highest in the Expressive condition ($M = 5976.47$ mm, SD = 1196.19), lowest in the Technical condition ($M = 4919.37$ mm, SD = 909.93), and in between in the Emotional condition ($M = 5247.00$ mm, SD = 877.80). The main effect of performance condition on amount of movement was significant, $F(1.490, 31.282) = 21.943$, $p < .001$. Post-hoc pair-wise comparisons revealed significant differences between the Technical and Expressive conditions ($p < .001$), between the Expressive and Emotional conditions ($p < .01$), and between the Technical and Emotional conditions ($p < .05$).

When looking at each marker separately (see Figure 3(a)), we can see that all markers, except the legs, follow the same movement pattern: the amount of movement is highest in the Expressive condition, lowest in the Technical condition, and in between in the Emotional condition. A series of repeated-measures ANOVAs revealed significant differences between performance conditions for all markers except the legs (right knee, right ankle and right toe, left ankle and left toe).[11]

The movement patterns shown by the amateurs and professionals were the same (i.e., moving most in the Expressive condition, least in the Technical condition, and in between in the Emotional condition). The amateurs in the sample, however, moved significantly more than the professionals, $t(60.092) = 4.068$, $p < .001$. As can be seen in Figure 3(b), this was the case for all markers except the hips. Independent *t*-tests revealed statistically significant differences in amount of movement of the right arm (elbow, wrist, finger), head, toes, and bow. These differences might be explained by differences in bowing technique, and differences in ancillary gestures such as counting along and turning the head to listen more closely to the instrument – all of which were observed in the video recordings.

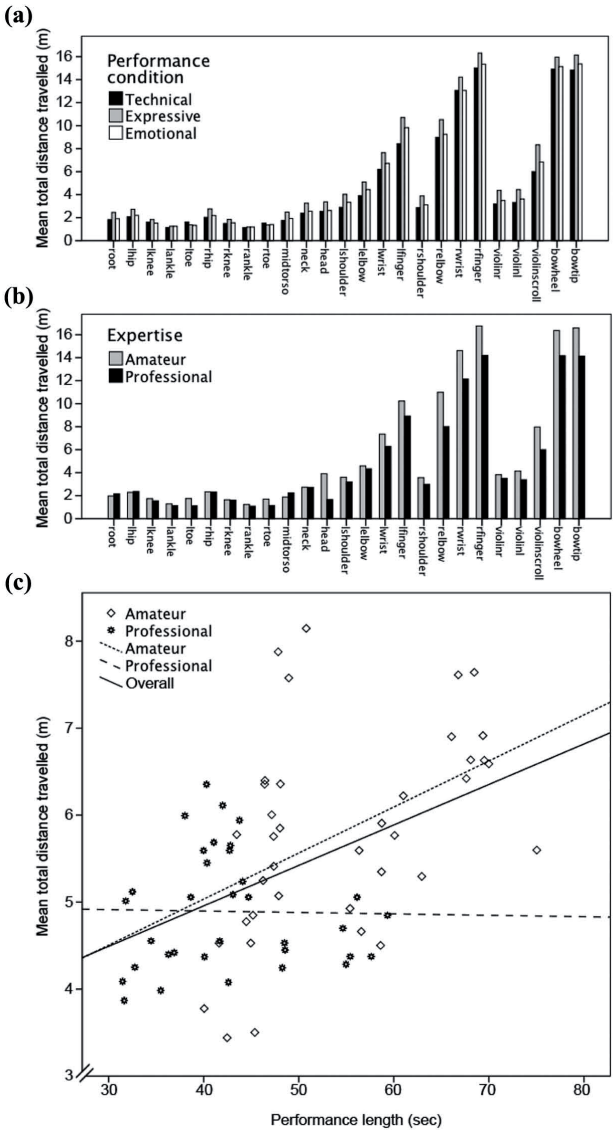

Figure 3. (a) Mean total distance travelled per marker, per performance condition, across all eight participants. (b) Mean total distance travelled per marker, across all performances, amateurs versus professionals. (c) Mean total distance travelled versus performance length

Figure 3(c) shows the overall regression line as well as the regression lines representing the performances of amateurs and professionals, respectively. As can be seen, performance length explains 22% of the variance in amount of movement overall, $R^2 = .221$, $F(1,70) = 19.899$, $p < .001$, and is a significant predictor of the average amount of movement, beta = 46.534, $t(70) = 4.461$, $p < .001$. Among amateurs, performance length explains 20% of the variance in amount of movement, $R^2 = .204$, $(1, 36) = 9.235$, $p < .01$, and is a significant predictor of the average amount of movement, beta = 52.946 $t(36) = 3.039$, $p < .01$. Among professionals, however, performance length explains 0% of the variance in amount of movement, $R^2 = .000$, $F(1, 32) = 0.012$, $p > .05$, and does not significantly predict the average amount of movement, beta = –1.623 $t(32) = –0.108$, $p > .05$.

To understand the difference between amateurs and professionals, we conducted simple linear regression analyses for each marker separately. We found that markers related to playing-related movements, such as markers on the left finger, and the right arm and bow, showed a positive linear relationship for both amateurs and professionals. Markers related to ancillary movements, such as markers on the hips and the head, however, showed a positive relationship for the amateurs, but a negative relationship for the professionals. This means that the differences in amount of playing-related movements between amateurs and professionals could be partly explained by the length of the performances. Differences in ancillary movements, however, could not be explained by performance length, and seemed to distinguish amateur from professional violinists.

Speed of movement

The average speed of movement was highest in the Expressive condition ($M = 118.97$ mm/sec, SD = 24.09), lowest in the Emotional condition ($M = 93.10$ mm/sec, SD = 21.24), and in between in the Technical condition ($M = 97.54$ mm/sec, SD = 22.84). The main effect of performance condition on speed of movement was significant, $F(1.532, 32.162) = 22.398$, $p < .001$. Post hoc pair wise comparisons revealed significant differences between the Technical and Expressive conditions ($p < .001$) and Expressive and Emotional conditions ($p < .001$) only.

When looking at each marker separately (see Figure 4(a)), we can see some differences in movement patterns. For all markers (except the toes), speed was highest in the Expressive condition. Speed of the bow (heel and tip) and right arm (elbow, wrist and finger) was clearly lowest in the Emotional condition. For the other markers, speed was lowest in the Technical condition – and often quite similar to the Emotional condition. Again, this seems to point towards a difference between playing-related movements (of the bow arm and bow) and ancillary movements. For all markers except the feet (ankles and toes), repeated-measures ANOVAs revealed significant differences between performance conditions.

The movement patterns shown by the amateurs and professionals were the same (i.e., moving fastest in the Expressive condition, slowest in the Emotional condition, and in between in the Technical condition). As can be seen in Figure 4(b), professionals moved faster than amateurs. This was the case for all markers except the feet, head, and right elbow. The difference was statistically significant for the root, mid-torso, and head. Averaged across all markers, however, the difference was not statistically significant, $t(70) = –1.610$, $p > .05$.

Figure 4(c) shows the overall regression line as well as the regression lines representing the performances of amateurs and professionals, respectively. As can be seen, performance length explains 33% of the variance in speed of movement overall, $R^2 = .328$, $F(1, 70) = 34.213$, $p < .001$, and is a significant predictor of the average speed of movement, beta = –1.295 $t(70) =$

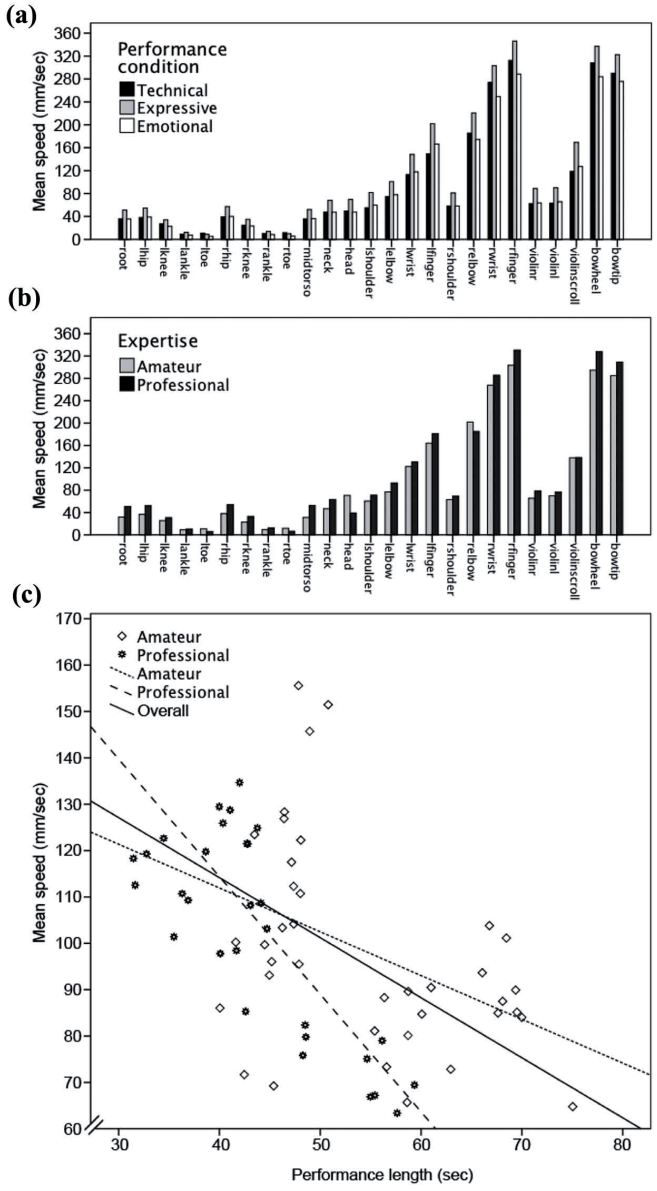

Figure 4. (a) Mean speed per marker, per performance condition, across all eight participants. (b) Mean speed per marker, across all performances, amateurs versus professionals. (c) Mean speed versus performance length

–5.849, $p < .001$. Among amateurs, performance length explains 17% of the variance in speed of movement, $R^2 = .174$, $F(1, 36) = 7.558$, $p < .01$, and is a significant predictor of the average speed of movement, beta = –0.944 $t(36) = –2.749$, $p < .01$. Among professionals, performance length explains 62% of the variance in speed of movement, $R^2 = .618$, $F(1, 32) = 51.724$, $p < .001$, and is a significant predictor of the average speed of movement, beta = –2.536 $t(32) = –7.192$, $p < .001$.

Simple linear regression analyses for each marker separately revealed similar relationships between speed of movement and performance length among amateurs and professionals for all markers except the lower torso (root, hips and mid-torso) and feet. For the lower torso and feet, amateurs showed a positive linear relationship between speed of movement and performance length whereas professionals showed a negative linear relationship.

Acceleration of movement

Average acceleration of movement was highest in the Expressive condition ($M = 957.75$ mm/sec^2, SD = 186.31), lowest in the Emotional condition ($M = 803.70$ mm/sec^2, SD = 195.66), and in between in the Technical condition ($M = 845.65$ mm/sec^2, SD = 182.99). The main effect of performance condition on acceleration of movement was significant, $F(1.446, 30.364) = 17.358$, $p < .001$. Post-hoc pair-wise comparisons revealed significant differences between the Technical and Expressive conditions ($p < .001$) and the Expressive and Emotional conditions ($p < .01$) only.

When looking at each marker separately (see Figure 5(a)), we can see that the left finger showed the highest acceleration in movement, and that, in contrast to the other markers, acceleration was higher in the Emotional condition as compared to the Technical condition. This might be explained by the use of *vibrato*: Participants used the least amount of *vibrato* in the Technical condition. A series of repeated-measures ANOVAs revealed significant differences between performance conditions for the lower torso (root, mid-torso, and hips), knees, right arm (shoulder, elbow and wrist), left finger, head, and violin (scroll and left site of the lower bout).

The movement patterns shown by the amateurs and professionals were the same (i.e., moving with highest acceleration in the Expressive condition, with lowest acceleration in the Emotional condition, and with average acceleration in the Technical condition). Professionals moved with significantly higher acceleration than amateurs, $t(70) = –3.026$, $p < .05$. As can be seen in Figure 5(b), this was the case for all markers except the head and toes. Independent *t*-tests revealed statistically significant differences in acceleration of movement of the right hand (wrist and finger) and bow heel, left finger, head, mid-torso, and left hip.

Figure 5(c) shows the overall regression line as well as the regression lines representing the performances of amateurs and professionals, respectively. As can be seen, performance length explains 37% of the variance in acceleration of movement overall, $R^2 = .618$, $F(1, 70) = 40.817$, $p < .001$, and is a significant predictor of the average acceleration of movement, beta = –10.801 $t(70) = –6.389$, $p < .001$. Among amateurs, performance length explains 10% of the variance in acceleration of movement, $R^2 = .100$, $F(1, 36) = 3.986$, $p > .05$, and does not significantly predict the average acceleration of movement, beta = –5.728 $t(36) = –1.996$, $p > .05$. Among professionals, performance length explains 73% of the variance in acceleration of movement, $R^2 = .727$, $F(1, 32) = 85.043$, $p < .001$, and is a significant predictor of the average acceleration of movement, beta = –19.620 $t(32) = –9.222$, $p < .001$.

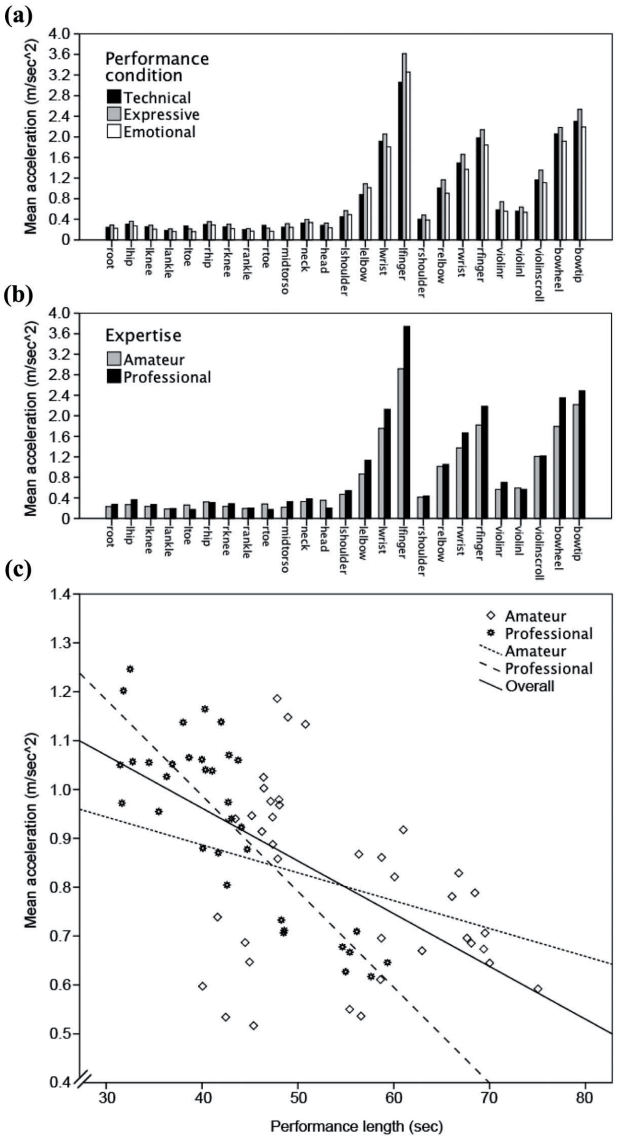

Figure 5. (a) Mean acceleration per marker, per performance condition, across all eight participants. (b) Mean acceleration per marker, across all performances, amateurs versus professionals. (c) Mean acceleration versus performance length

Simple linear regression analyses for each marker separately revealed similar relationships between acceleration of movement and performance length among amateurs and professionals for all markers except the lower torso (root and right hip), left arm (elbow and wrist), and feet. For these body parts, amateurs showed a positive linear relationship between acceleration of movement and performance length whereas professionals showed a negative linear relationship.

Smoothness of movement

Average jerk was lowest in the Emotional condition ($M = 25893.20$ mm/sec^3, SD = 6027.10), highest in the Expressive condition ($M = 29168.12$ mm/sec^3, SD = 5031.98), and in between in the Technical condition ($M = 26796.81$ mm/sec^3, SD = 5584.76). Since smoothness is the reverse of jerk, this means that smoothness of movement was highest in the Emotional condition, lowest in the Expressive condition, and in between in the Technical condition. The main effect of performance condition on smoothness of movement was significant, $F(2, 42) = 12.276$, $p < .001$. Post-hoc pair-wise comparisons revealed significant differences between the Technical and Expressive conditions ($p < .01$) and the Expressive and Emotional conditions ($p < .01$) only.

When looking at each marker separately (see Figure 6(a)), we can see that for most markers the movements were least smooth in the Expressive condition and most smooth in the Emotional condition. This was not the case for the toes and the left arm (shoulder, elbow, and finger), which might be explained by participants counting along in the Technical condition, and the use of *vibrato* in the Emotional condition. A series of repeated-measures ANOVAs revealed significant differences between performance conditions for the lower torso (root, mid-torso, and hips), knees, left finger, right shoulder, and head.

The movement patterns shown by the amateurs and professionals were the same (i.e., moving most smoothly in the Emotional condition, least smoothly in the Expressive condition, and average in the Technical condition). Amateurs moved significantly more smoothly than professionals, $t(70) = -3.628$, $p < .05$. As can be seen in Figure 6(b), this was the case for all markers except the toes, head, and violin scroll. Independent *t*-tests revealed statistically significant differences in smoothness of movement of the head, mid-torso, left hip, left elbow and left finger, right wrist, right finger, and bow heel.

Figure 6(c) shows the overall regression line as well as the regression lines representing the performances of amateurs and professionals, respectively. As can be seen, performance length explains 27% of the variance in smoothness of movement overall, $R^2 = .274$, $F(1, 70) = 26.447$, $p < .001$, and is a significant predictor of the average smoothness of movement, beta $= -272.920$ $t(70) = -5.143$, $p < .001$. Among amateurs, performance length explains 1% of the variance in smoothness of movement, $R^2 = .010$, $F(1, 36) = .377$, $p > .05$, and does not significantly predict the average smoothness of movement, beta $= -55.116$ $t(36) = -0.614$, $p > .05$. Among professionals, performance length explains 75% of the variance in smoothness of movement, $R^2 = .750$, $F(1, 32) = 96.115$, $p < .001$, and is a significant predictor for the average smoothness of movement, beta $= -537.194$ $t(32) = -9.804$, $p < .001$.

Simple linear regression analyses for each marker separately revealed similar relationships between smoothness of movement and performance length among amateurs and professionals for all markers except the lower torso (root and right hip), left arm (elbow and wrist), feet, and violin scroll. For all these markers, amateurs showed a positive linear relationship between jerk

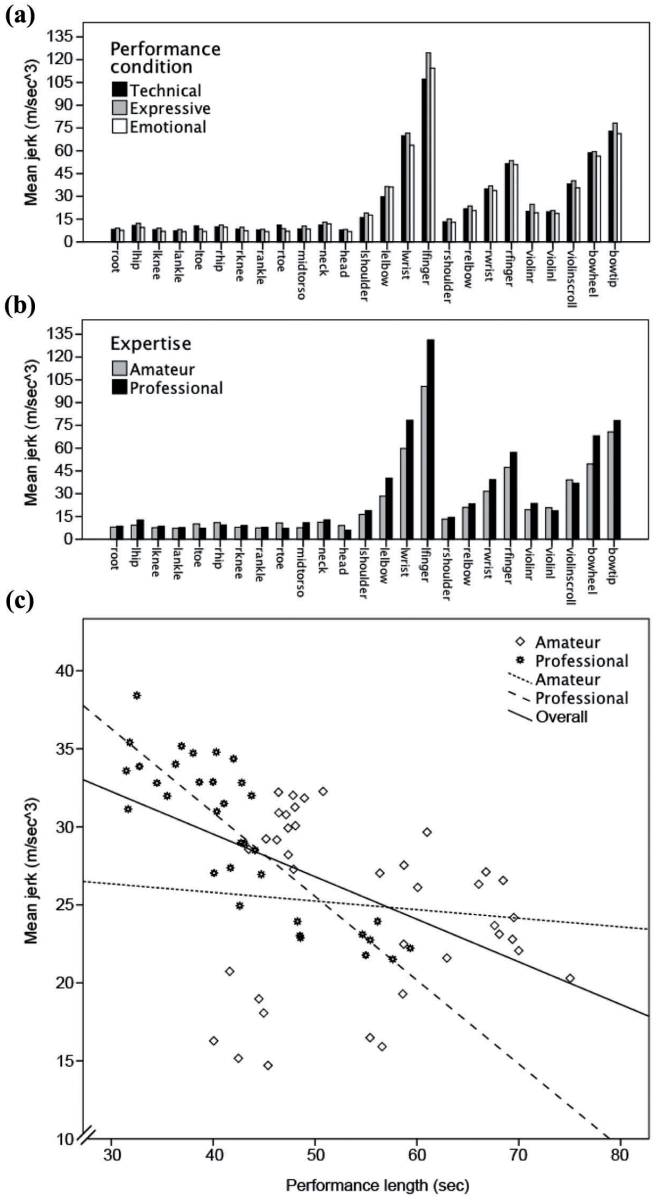

Figure 6. (a) Mean jerk per marker, per performance condition, across all eight participants. (b) Mean jerk per marker, across all performances, amateurs versus professionals. (c) Mean jerk versus performance length

of movement and performance length whereas professionals showed a negative linear relationship.

Summary and discussion

What is the effect of performers' experienced emotions on their movement characteristics? We attempted to answer this question by asking performers to play a musical phrase in response to three different instructions – focus on technique; focus on expressivity; focus on experienced emotions. We analysed the amount, speed, acceleration, and smoothness of the performers' movements, as well as their body posture.

We found that the emotions experienced by performers affected the movement characteristics of their performances. As summarized in Table 2, each performance condition revealed a different pattern of movement characteristics.

In the Technical performances, participants moved least, with medium speed, medium acceleration, and medium smoothness. It seems that in the Technical condition, participants performed the movements needed to execute the notes, nothing more and nothing less. In the interviews, most participants indicated that it felt natural to focus on technique: "When you are studying music, that's the first thing to focus on." Some participants, however, felt a bit inhibited: "Maybe it restricted me a bit, because I wasn't sure if I could express like any emotions." None of the participants rated their Technical performances as their best.

In the Expressive performances, participants moved most, fastest, with most acceleration, and lowest levels of smoothness. Here, it seems that the instruction to give an expressive performance may have had the effect of inducing an attempt to play to an (imaginary) audience, suggesting a greater amplitude of sound required to reach the back of a performance space, resulting in more accelerated and jerkier movements. This potential explanation was supported by the interview data. In the words of one of the participants: "When I was thinking that there was an audience [the Expressive condition] I played bigger and … I played to someone, not to myself like I played the last and the first ones."

That participants moved more and more distinctly when playing expressively supports the findings by Davidson (2007), Thompson and Luck (2008, 2012), and Wanderley (2002). That participants moved with more accelerated and jerkier movements might be due to articulation of the musical structure by indicating important parts in the music (such as the beginning of a phrase) by means of more body movement. This supports the findings by Thompson and Luck (2012), Vines, Wanderley, Krumhansl, Nuzzo, & Levitin (2004), and Wanderley et al. (2005).

Participants moved fastest in the Expressive performances. In violin playing, the speed of the bow (along with bow-pressure and distance from the bridge) affects the loudness and timbre of the sound. Usually, faster movements (when keeping the bow-pressure and distance constant) result in a more intense sound (Gerle, 1991). To investigate whether the different instructions and associated movement characteristics affected the sound intensity, we estimated the average

Table 2. Main overview of the movement characteristics investigated

	Amount (total distance travelled)	Speed	Acceleration	Smoothness (reversed jerk)
Technical	Low	Medium	Medium	Medium
Expressive	High	High	High	Low
Emotional	Medium	Low	Low	High

loudness by calculating the root mean square energy (RMS) of each performance. The findings confirm that participants played louder in the Expressive performances as compared to the Emotional and Technical performances.[12]

In the Emotional performances, participants moved with a moderate amount of movement, minimal speed, minimal acceleration, and highest levels of smoothness. Here, it seems that participants were more "inwardly-oriented," focusing on their own emotions and feelings towards the music, resulting in less, slower, and smoother movements. This interpretation was supported by the interview data. In the words of one of the participants: "[in the Emotional condition] I was thinking about crying, about blackness, about sadness. [...] And then I got a feeling here [points towards her breast]. I was just feeling that, just physically listening to my body."

According to the literature, distinct emotions are often associated with certain qualities of body movement (Castellano, Villalba & Camurri, 2007; Crane & Gross, 2007; Wallbott, 1998). As found by Crane and Gross (2007), sadness is characterized by a slower speed, a lower amplitude of upper extremity motion, a lower range of motion in shoulders, elbows and hips, and a downward orientation of the head and upper body. The similarity with our findings seems to indicate that in the Emotional condition the performers were indeed affected by sadness, and that their sadness was expressed in the characteristics of their movements and body posture.

As shown by the regression analyses, the movement patterns were partly explained by the length of the performances. The performance length was shortest in the Expressive condition, longest in the Emotional condition, and in between in the Technical condition. Overall, performance length explained between 22% and 38% of the variance in movement features.

We also found differences in patterns of movement characteristics between amateurs and professionals. As summarized in Table 3, the amateurs moved more, but more slowly, more smoothly, and with less acceleration than the professionals. As shown by the regression analyses, among amateurs, performance length explained between 1% and 20% of the variance in movement features. Among professionals, performance length explained between 0% and 75% of the variance in movement features: as there was no relationship between amount of movement and performance length among the professional players, the relationship between performance length and speed, acceleration, and jerk respectively, had to be strongly negative. If a performer does not move less during a shorter performance, they must move faster.

How might we explain the differences found between amateurs and professionals? One explanation might be related to differences in technical skill. As indicated before, the performances of the amateurs were much longer than those by the professionals. Less skilled players might have chosen a slower tempo to ensure that they could cope with the technical demands of the phrase. In addition, bowing at a faster rate requires more expertise, and might be related to the production of a more intense sound (Gerle, 1991). To investigate whether a difference in speed of movement affected the sound intensity, we estimated the average loudness by

Table 3. Main overview of the movement characteristics of amateurs and professionals

	Amount (total distance travelled)	Speed	Acceleration	Smoothness (reversed jerk)
Amateurs	High	Low	Low	High
Professionals	Low	High	High	Low

calculating the RMS of each performance. The results confirmed that the professionals in the sample played louder than the amateurs.[13]

Overall, the amateurs moved more than the professionals. When investigating all markers separately, however, a difference was found between markers related to the sound production (such as the bow and right arm) and markers related to ancillary movements (such as the head and hips). Whereas the amateurs did not move more in terms of playing-related movements, they did make more ancillary movements. This finding might be due to individual player characteristics. It might also be related to a certain efficiency of movement: professional players might make less "unnecessary" movements that might interfere with their playing. Professional players, meanwhile, moved less smoothly and with a higher acceleration than the amateurs. This seemed to be related to a more distinct gesticulation of the musical structure (e.g., Vines et al., 2004), which in turn seems to be related to the intention of bringing the musical meaning across to an audience – a skill that most likely develops with increasing expertise and performance experience.

Some limitations of the present study should be acknowledged, such as the small sample size, the limited differentiation between amateurs and professionals, and the non-randomization of playing conditions to ensure that the Technical and Expressive condition were not affected by the mood induction task. In particular, the non-randomization of the playing conditions could be regarded as problematic. It could be argued that the performers might have become more comfortable, or perhaps bored, by playing the piece several times. However, the fact that the amount, speed, acceleration, and jerk of movement increased from the first to second recording session but decreased from the second to third session suggests that the effects reported here are not mere order effects.

The findings are significant in several regards. First, the use of motion-capture technology to study the effect of felt emotion on musical performance seems promising. In future studies, the analyses might be extended by looking at time series of movement data rather than at mean data, and by investigating aspects such as movement per bar or musical unity. Changes in angles of body and instrument segments such as the hips, the shoulders, the head, and the violin and bow, might be interesting to investigate as well. Second, the findings seem to offer concrete evidence for the difference between emotional and expressive playing suggested by Van Zijl and Sloboda (2011). It is important to note, however, that we only looked at performances of a sad phrase. In the case of an emotion such as anger, one may well find different results. Future research might examine this issue. Third, in addition to their value for music research, the findings are interesting concerning the debate about whether felt and posed/portrayed emotions result in similar (vocal, facial, bodily) expressions (e.g., Bachorowski & Owren, 2003; Crane & Gross, 2007; Banse & Scherer, 1996; Wallbott, 1998; Zuckerman et al., 1976). The present findings suggest that felt and portrayed emotions in music result in different expressions. Future research might address the perceptibility of certain differences by an audience, the interaction between movement and audio features, and, ultimately, what type of performance or expression an audience prefers.

Sometimes a performance is perfect, yet there seems to be something missing. The present study has shown that performers' experienced emotions affect their movement characteristics: the performers in the present study were literally "moved through music." Whether this might hint at the elusive feature that turns a perfect performance into a remarkable one remains to be discovered.

Funding

The research reported here was supported by the Academy of Finland (project numbers 7118616 and 125710).

Acknowledgements

We would like to thank Birgitta Burger, Marc R. Thompson, and Petri Toiviainen for their help with the movement feature extraction. We would also like to thank the musicians who took part in the study, and four anonymous reviewers and the editor for their valuable comments.

Notes

1. Since this was the first recording session, we could make sure that all participants were familiar with the music and the research set-up once they started with the Expressive and Emotional recording sessions. Although we were especially interested in comparing Expressive and Emotional performances, we included the Technical performances in the analyses as well, because striving for technical perfection is a salient aspect in classical music performance (e.g., Chaffin, Imreh, & Crawford, 2002).
2. Although the research was conducted in Finland, the entire study, including the interviews, was conducted in English.
3. One participant gave five Technical performances, another participant gave four Expressive performances, and a third participant gave only two performances per performance condition. To obtain an equal number of performances per performance condition, the "extra" performances (i.e., the fourth and fifth Technical performances of one participant, and the fourth Expressive performance of another participant) were excluded from analyses.
4. As we thought it might be too personal to tell an experimenter about a sad personal experience, we left the choice as to either write or speak about an experience up to the participant. This resulted in six participants telling about an experience, and two participants writing about it.
5. Seven out of eight participants had played the phrases through once or several times prior to the experiment. The time spent on this ranged from 5 to 45 minutes. The amateurs spent more time (mean time: 26.25 minutes, SD: 14.93) than the professionals (mean time: 11.25 minutes, SD: 11.09) on playing the phrases. None of the participants tried to memorize the phrases.
6. The reduced marker set-up was obtained by averaging the location of the head markers, the wrist markers, the hip markers, and the feet markers. The breast and back marker were averaged to create the mid-torso marker, the shoulders were averaged to create the neck marker, and the hips were averaged to create the root marker.
7. We use the physical terms (i.e., total distance travelled, speed, acceleration, jerk) in the figures, and the derivative terms of total distance travelled (i.e., amount of movement) and jerk (i.e., smoothness of movement) in the main text.
8. See n. 3 above.
9. The markers on the violin were placed on the scroll and on the left and right side of the lower bout. In the Figures we refer to them as violin scroll, violin left and violin right, respectively. The markers on the bow were placed above the right hand and on the tip. In the Figures, we refer to them as bow heel and bow tip.
10. Three participants showed both a decrease in positive PANAS score and an increase in negative PANAS score.
11. To save space we decided not to include the detailed results of the repeated measures ANOVAs and independent *t*-tests conducted for each marker separately. Instead, we summarize the findings of the overall tests by indicating which markers differed significantly at the Bonferroni corrected significance level. We adjusted the significance level to control for the number of tests conducted (i.e., $p = .05/\ 25$ tests = $p(adjusted) = .002$).
12. The RMS value was highest in the Expressive condition ($M = 0.0336$, SD = 0.00669), lower in the Technical condition ($M = 0.0315$, SD = 0.00788), and lowest in the Emotional condition ($M = 0.0276$, SD = 0.00523). The main effect of performance condition on RMS value was significant, $F(1.37, 30.03) = 12.23$, $p < .01$. Post-hoc pair-wise comparisons with Bonferroni correction revealed significant differences between the Technical and Expressive conditions ($p < .05$), between the

Technical and Emotional conditions ($p < .05$), and between the Expressive and Emotional conditions ($p < .01$).

13. The performances of the professionals ($M = 0.035$, SD = 0.006) revealed a higher RMS value than the performances of the amateurs ($M = 0.027$, SD = 0.006), $t(67) = -5.47$, $p < .001$.

References

Altenmuller, E., & Schneider, S. (2009). Planning and performance. In S. Hallam, I. Cross & M. Thaut (Eds.), *The Oxford Handbook of Music Psychology* (pp. 332–343). Oxford: Oxford University Press.

Armontraut, J. A., Schutz, M., & Kubovy, M. (2009). Visual determinants of a cross-modal illusion. *Attention, Perception, & Psychophysics, 71*(7), 1618–1627.

Bachorowski, J. -A., & Owren, M. J. (2003). Sounds of emotion. Production and perception of affect-related vocal acoustics. *Annals of the New York Academy of Sciences, 1000*, 244–265.

Banse, R., & Scherer, K. R. (1996). Acoustic profiles in vocal emotion expression. *Journal of Personality and Social Psychology, 70*(3), 614–636.

Castellano, G., Villalba, S. D., & Camurri, A. (2007). Recognising human emotions from body movement and gesture dynamics. In A. Paiva, R. Prada, & R. W. Picard (Eds.), *Affective computing and intelligent interaction: Lecture notes in computer science* (Vol. 4738; pp. 71–82). Berlin: Springer-Verlag.

Chaffin. R., Imreh, G., & Crawford, M. (2002). *Practicing perfection: Memory and piano performance*. Mahwah, NJ/ London: Lawrence Erlbaum Associates.

Chaffin, R., Lemieux, A., & Chen, C. (2007). "It's different each time I play": Spontaneity in highly prepared musical performance. *Music Perception, 24*, 455–472.

Crane, E., & Gross, M. (2007). Motion capture and emotion: Affect detection in whole body movement. Recognising human emotions from body movement and gesture dynamics. In A. Paiva, R. Prada, & R. W. Picard (Eds.), *Affective computing and intelligent interaction: Lecture notes in computer science* (Vol. 4738; pp. 95–101). Berlin: Springer-Verlag.

Davidson, J. W. (1993). Visual perception of performance manner in the movements of solo musicians. *Psychology of Music, 21*, 103–113.

Davidson, J. W. (2001). The role of the body in the production and perception of solo vocal performance: A case study of Annie Lennox. *Musicae Scientiae,* 5(2), 235–256.

Davidson, J. W. (2007). Qualitative insights into the use of expressive body movement in solo piano performance: A case study approach. *Psychology of Music, 35*, 381–401.

Davidson, J. W., & Correia, J. S. (2002). Body movement. In R. Parncutt & G. E. McPherson (Eds.), *The science and psychology of music performance* (pp. 237–250). Oxford: Oxford University Press.

Gabrielsson, A. (2001–2002). Emotion perceived and emotion felt: Same or different? *Musicae Scientiae* [special issue], 123–147.

Gerle, R. (1991). *The art of bowing practice: The expressive bow technique*. London: Stainer & Bell.

Glowinsky, D., Camurri, A., Volpe, G., Chiarra, N., Cowie, R., McMahon, E., et al. (2008). Using induction and multimodal assessment to understand the role of emotion in musical performance. In C. Peter, E. Crane, M. Fabri, H. Agius, & L. Axelrod (Eds.), *Proceedings of the workshop Emotion in HCI – Designing for People* (pp. 8–12). Fraunhof: Fraunhofer Verlag.

Hallam, S. (1995). Professional musicians' approaches to the learning and interpretation of music. *Psychology of Music, 23*, 111–128.

Harty, H. (1911). *Three miniatures for oboe and piano: Orientale, Chansonette, A la campagne*. London: Stainer & Bell.

Higuchi, M. K. K., Fornari, J. E., & Leite, J. P. (2010). The influence of cognition and emotion in pianistic performance. In S. M. Demorest, S. J. Morrison, & P. S. Campbell (Eds.), *Proceedings of the 11th International Conference on Music Perception and Cognition (ICMPC11)* (pp. 186–191). Seattle, WA: The University of Washington.

Juchniewicz, J. (2008). The influence of physical movement on the perception of musical performance. *Psychology of Music, 36*(4), 417–427.

Juslin, P. N. (2001). Communicating emotion in music performance: A review and theoretical framework.

In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 309–337). Oxford: Oxford University Press.

Juslin, P. N. (2003). Five facets of musical expression: A psychologist's perspective on music performance. *Psychology of Music, 31*(3), 273–302.

Juslin, P. N. (2009). Emotion in music performance. In: S. Hallam, I. Cross, & M. Thaut (Eds.), *The Oxford Handbook of Music Psychology* (pp. 377–389). Oxford: Oxford University Press.

Juslin, P. N., & Västfjäll, D (2008). Emotional responses to music: The need to consider underlying mechanisms. *Behavioral and Brain Sciences, 31*, 559–575.

Karlsson, J., & Juslin, P. N. (2008). Musical expression: An observational study of instrumental teaching. *Psychology of Music, 36*(3), 309–334.

Lindström, E., Juslin, P. N., Bresin, R., & Williamon, A. (2003). "Expressivity comes from within your soul": A questionnaire study of music students' perspectives on expressivity. *Research Studies in Music Education, 20*, 23–47.

Persson, R. S. (2001). The subjective world of the performer. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 275–289). Oxford: Oxford University Press.

Persson, R. S., Pratt, G., & Robson, C. (1992). Motivational and influential components of musical performance: A qualitative analysis. *European Journal for High Ability, 3*, 206–217.

Reid, A. (2001). Variation in the ways that instrumental and vocal students experience learning music. *Music Education Research, 3*(1), 25–40.

Sakata, M., Wakamiya, S., Odaka, N., & Hachimura, K. (2009). Effect of body movement on music expressivity in jazz performances. In Jacko, J. A. (Ed.), *Human–computer interaction, Pt I* (Vol. 5610, pp. 159–168). Berlin: Springer-Verlag.

Schutz, M. (2008). Seeing music? What musicians need to know about vision. *Empirical Musicology Review, 3*(3), 83–108.

Sloboda, J. A. (1996). The acquisition of musical performance expertise: Deconstructing the "talent" account of individual differences in musical expressivity. In K. A. Ericsson (Ed.), *The road to excellence. The acquisition of expert performance in the arts and sciences, sports and games.* Mahwah, NJ: Lawrence Erlbaum.

Sloboda, J. A. (2000). Individual differences in music performance. *Trends in Cognitive Sciences, 4*(10), 397–403.

Sloboda, J. A., Minassian, C., & Gayford, C. (2003, August). *Assisting advanced musicians to enhance their expressivity – an intervention study.* Paper presented at the 5th Triennial ESCOM Conference, Hanover University of Music and Drama, Germany.

Thompson, M. R., & Luck, G. (2008). Effect of pianists' expressive intention on amount and type of body movement. In K. Miyazaki, M. Adachi, Y. Hiraga, Y. Nakajima, & M. Tsuzaki (Eds.), *Proceedings of the 10th International Conference for Music Perception and Cognition (ICMPC10)* (pp. 540–544). Sapporo, Japan: Hokkaido University.

Thompson, M. R., & Luck, G. (2012). Exploring relationships between pianists' body movements, their expressive intentions, and structural elements of the music. *Musicae Scientiae, 16*(1), 19–40.

Timmers, R., & Honing, H. (2002). On music performance, theories, measurement and diversity. In M. A. Belardinelli (Ed.), *Cognitive Processing (International Quarterly of Cognitive Sciences)*, 1–2, 1–19.

Toiviainen, P., & Burger, B. (2010). *MoCap Toolbox manual.* Retrieved from University of Jyväskylä: Jyväskylä, Finland: http://www.jyu.fi/music/coe/materials/mocaptoolbox/MCTmanual

Van Zijl, A. G. W. (2008). *The role of the performer's experienced emotion in the construction of a musically expressive performance*. Unpublished master's dissertation, Keele University, UK.

Van Zijl, A. G. W., & Sloboda, J. (2011). Performers' experienced emotions in the construction of expressive musical performance: An exploratory investigation. *Psychology of Music, 39*(2), 196–219.

Vines, B. W., Wanderley, M. M., Krumhansl, C. L., Nuzzo, R. L., & Levitin, D. J. (2004). Performance gestures of musicians: What structural and emotional information do they convey? In A. Camurri & G. Volpe (Eds.), *Gesture-based communication in human–computer interaction* (pp. 468–478). Berlin: Springer-Verlag.

Vuoskoski, J. K., & Eerola, T. (2011). The role of mood and personality in the perception of emotions represented by music. *Cortex, 47*(9), 1099–1106.
Wallbott, H. G. (1998). Bodily expression of emotion. *European Journal of Social Psychology, 28*, 879–896.
Wanderley, M. M. (1999). Non-obvious performer gestures in instrumental music. In A. Braffort, R. Gherbi, S. Gibet, J. Richardson, & D. Teil (Eds.), *Gesture-based communication in human–computer interaction* (pp. 37–48). Berlin: Springer.
Wanderley, M. M. (2002). Quantitative analysis of non-obvious performer gestures. In I. Wachsmuth & T. Sowa (Eds.), *Gesture and sign language in human–computer interaction* (pp. 241–253). Berlin: Springer Verlag.
Wanderley, M. M., Vines, B. W., Middleton, N., McKay, C., & Hatch, W. (2005). The musical significance of clarinetists' ancillary gestures: An exploration of the field. *Journal of New Music Research, 34*(1), 97–113.
Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect – the Panas Scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070.
Woody, R. H. (2000). Learning expressivity in music performance: An exploratory study. *Research Studies in Music Education, 14*, 14–23.
Zentner, M., Grandjean, D., & Scherer, K. R. (2008). Emotions evoked by the sound of music: Characterization, classification, and measurement. *Emotion, 8*(4), 494–521.
Zuckerman, M., Hall, J. A., DeFrank, R. S., & Rosenthal, R. (1976). Encoding and decoding of spontaneous and posed facial expressions. *Journal of Personality and Social Psychology, 34*(5), 966–977.

Author biographies

Anemone G. W. Van Zijl has a background in Arts and Social Sciences (BA and MPhil at Maastricht University, The Netherlands) and Music Psychology (MSc at Keele University, UK). Since 2009 she has been a doctoral student within the Finnish Centre of Excellence in Interdisciplinary Music Research, University of Jyväskylä, Finland. In her research she combines quantitative (e.g., motion capture, audio) and qualitative (e.g., interview, diary) research methods to investigate the relationship between performers' experienced emotions and the expressivity of the produced performances.

Geoff Luck is an Academy of Finland Research Fellow within the Finnish Centre of Excellence in Interdisciplinary Music Research at the Department of Music, University of Jyväskylä, Finland. Using a combination of motion capture, computational, and statistical modelling techniques, he studies the role of the body in musical communication, perception, and cognition. He is currently leads a five-year research project entitled "The Kinematics and Dynamics of Musical Communication."

III

THE SOUND OF EMOTION: THE EFFECT OF PERFORMERS' EXPERIENCED EMOTIONS ON AUDITORY PERFORMANCE CHARACTERISTICS

by

Anemone G. W. Van Zijl & Petri Toiviainen & Olivier Lartillot & Geoff Luck

Music Perception, in press

THE SOUND OF EMOTION: THE EFFECT OF PERFORMERS' EXPERIENCED EMOTIONS ON AUDITORY PERFORMANCE CHARACTERISTICS

Anemone G. W. Van Zijl, Petri Toiviainen, Olivier Lartillot, Geoff Luck

Finnish Centre of Excellence in Interdisciplinary Music Research,
Department of Music, University of Jyväskylä, Finland

Accepted for *Music Perception*

What is the effect of performers' experienced emotions on the auditory characteristics of their performances? By asking performers to play a musical phrase in response to three different instructions we attempted to answer this question. Performers were first asked to play while focusing on the technical aspects of their playing. Second, to give an expressive performance. Third, to focus on their experienced emotions, prior to which they were subjected to a sadness-inducing mood induction task. Performers were interviewed after each playing condition. We analyzed the tempo, articulation, dynamics, timbre, and vibrato of the performances obtained as well as the interview data. A focus on technique resulted in technically appropriate performances, a focus on expressivity in more extraverted and externally projected performances, and a focus on experienced emotions in more introverted and personal performances. The findings of this exploratory study are valuable for both research and artistic practice and pedagogy.

Keywords: Audio analysis, felt emotion, expressive performance, emotional performance, performing musicians

INTRODUCTION

Performing musicians face the question of how to best achieve an expressive performance. Should they, for instance, feel the emotions present in the music, or should they rather rely on the use of appropriate technical means, such as tempo, dynamics, articulation, and timbre? Moreover, does their focus have an effect on the auditory characteristics of their performances?

The opinions regarding the presence of performers' emotions in expressive performance differ. Some studies underline the idea of planned expressiveness. They indicate that performers usually meticulously practice and plan their performances beforehand (e.g., Chaffin, Imreh & Crawford, 2002; Chaffin, Lemieux & Chen, 2007). Since performers have to play the same piece over and over again, and move their audience night after night, it is likely that their expressive conveyance becomes highly automatic, and has nothing to do with their actual emotions while performing (Juslin, 2009). Also, many professional performers state that the music occupies centre stage, not the performer or his or her emotions (e.g., Sloboda & Lehmann, 2001). Other studies emphasize the importance of feeling the emotions. They stress the need to actually feel the emotions in the music to be able to convincingly express them to an audience (e.g., Persson, Pratt & Robson, 1992; Persson, 2001; Lindström, Juslin, Bresin & Williamon, 2003).

In several studies (e.g., Woody, 2000; Karlsson & Juslin, 2008; Juslin, 2009), emotional and expressive playing are considered as being one and the same. Van Zijl and Sloboda (2011), however, found that music students described "emotional playing" as "just feeling and enjoying the music" and "expressive performance" as "the conveyance of a previously constructed musical interpretation to an audience". With the present study, we aim to explore this proposed difference, and investigate the effect of performers' experienced emotions on the auditory characteristics of their performances.

Most research in the field of music and emotion has focused on listeners' ability to recognize emotions expressed through music in general (for some reviews, see: Gabrielsson & Juslin, 2003; Juslin & Laukka, 2003; Eerola & Vuoskoski, 2013). Only a limited number of these studies have investigated performers' ability to successfully communicate emotions to listeners. In most of these investigations, musicians are asked to play brief melodies with various emotional expressions. The question of how musicians approach this task is usually not part of the investigation. The resulting performances are evaluated in perceptual experiments, and sometimes analyzed in terms of acoustic features. As a result, the acoustic features associated with the musical expression of emotions such as happiness, sadness, anger, fear, and tenderness have been described in detail (Juslin, 2009). Sadness for instance, is characterized by features such as a minor mode, slow tempo, large timing variability, low sound level, moderate sound level variability, legato articulation, slow note attacks, flat intonation, dull timbre, and a slow vibrato (Juslin, 2009, p. 382). Different performers have been found to use different acoustic features in order to communicate the same emotion. Despite differences in use of acoustic features, different performers can communicate the same emotion equally well (Juslin, 2000).

Although listeners' perception of emotions expressed through music has been studied extensively, questions such as how performers actually try to achieve a convincing expression, and what the effect of different approaches might be on performance characteristics, have rarely been investigated. In an article examining the distinction between perceived and induced emotion in listeners, Gabrielsson (2001-2002) has put forward the question of how performing artists best achieve a convincing expression. He wonders whether performing musicians achieve an expressive performance by the technical use of appropriate musical means such as tempo, articulation, and timing without any personal engagement, or whether they try to push themselves into the same feeling as perceived in the music. A third possibility Gabrielsson suggests is that performers adopt an intermediate position: "they strive for emotional identification but still have some conscious control of performance" (p. 138). The findings of an exploratory study by Van Zijl and Sloboda (2011) suggest the latter. The present study investigates whether the different positions proposed by Gabrielsson are merely a matter of a performer's preference, or whether they also have an effect on auditory performance characteristics.

To the authors' knowledge, only three studies addressing the effect of performers' experienced emotions on the resulting performances have been published to date. Higuchi, Fornari, and Leite (2010) subjected nine pianists to a sadness-inducing mood induction procedure before they performed a piece for four hands by R. Schumann – with the main researcher as co-performer – once while focusing on each note, and once while thinking of the emotional stimuli. Higuchi et al. found that participants played more legato and with less metric precision in the emotional playing condition. Glowinsky et al. (2008) subjected two violinists to a mood induction procedure before they performed several pieces by J.S. Bach in an angry, sad, joyful and peaceful manner. Analyses of audio, video and physiological recordings revealed differences in duration time of the performances, differences in heart rate, galvanic skin response, and tension in the right arm. The authors did not specify the differences in relation to the performance conditions. In a paper related to the study reported here, Van Zijl and Luck (2013a) investigated the effect of violinists' experienced emotions on their body posture and movement characteristics. They found that the performers were standing most upright when asked "to give an expressive performance", bent slightly backwards when asked "to focus on the technical aspects of their playing", and, after being subjected to a sadness-inducing mood induction procedure, bent further back when asked "to focus on their experienced emotions". In addition, they found that the performers moved most, fastest, with most acceleration, and lowest levels of smoothness in the Expressive condition, that they moved least, with medium speed, medium acceleration, and medium levels of smoothness in the Technical condition, and that they moved with a moderate amount of movement, minimal speed, minimal acceleration, and highest levels of smoothness in the Emotional condition. Based on these findings, Van Zijl and Luck concluded that performers' experienced emotions have an effect on the movement characteristics of their performances, and that felt and expressed emotions in music result in different performance expressions.

The question of whether felt and expressed emotions result in similar expressions has been posed in relation to vocal, facial, and bodily expressions (e.g., Erickson, Yoshida, Menezes, Fujino, Mochida & Shibuya, 2006; Bachorowski & Owren, 2003; Spackman, Brown & Otto, 2009; Banse & Scherer, 1996; Zuckerman, Hall, DeFrank & Rosenthal, 1976; Crane & Gross, 2007; Wallbott, 1998). The literature on vocal expression of emotions seems to be particularly relevant to the present study. Based on a review of 104 studies of vocal expression and 41 studies of music performance, Juslin and Laukka (2003) concluded that vocal and musical expression of emotions show similarities in the accuracy with which discrete emotions can be communicated to listeners, and the emotion-specific patterns of acoustic cues used to communicate each emotion. Of the musical expression studies included in the review, none looked at the effect of felt emotions on performance expressions: They all used portrayal, manipulated portrayal, or synthesis methods. Of the vocal expression studies included, 7 used mood induction procedures, and 12 used natural speech examples. The remaining ones used emotion portrayals of actors and manipulations of portrayals. According to Erickson et al. (2006), these methods are problematic: "Using actors in emotion studies will give results on paralanguage and not results on emotion as such. Therefore, to study emotional

characteristics of speech (articulatory phonetics etc.) researchers need to move away from using actors." In an innovative study, Erickson et al. investigated the acoustic and articulatory (i.e., the settings of the lips, tongue, and lower jaw measured via Electro Magnetic Articulography) characteristics of spontaneously produced sad speech, imitated sad speech, imitated intonation speech, and read speech. They found that the F0, F1 and voice quality of spontaneous and imitated sad speech were similar to each other, but differed from the read and imitated intonation conditions. Interestingly, the average durations of the imitated sad speech utterances were longer than those of the spontaneous, read, and imitated intonation speech. The authors suggest that this might be because the speakers expected sad speech to be slow, which might have influenced their speech production. In terms of articulatory characteristics, imitated sad speech was found to be similar to read and imitated intonation speech, rather than to spontaneous sad speech. The authors suggest that the different pattern of articulation may be not for the purpose of conveying sadness, but the by-product of experiencing sadness. Of particular interest is their finding that imitated sad speech received higher ratings of sadness than spontaneous sad speech. The authors suggest that there may be a set of stereotypes of what constitutes sad speech, which are not necessarily the same as those actually present in spontaneous sad speech. In sum, there seems to be a difference between felt and expressed vocal expression of emotion.

To explore the potential difference between emotional and expressive playing as proposed by Van Zijl and Sloboda (2011), and investigate the effect of performers' focus as proposed by Gabrielsson (2001-2002) on the auditory characteristics of their performances, we conducted an experimental study in which we asked performers to play a melodic phrase in response to three different instructions. We aimed to stay as close as possible to practices musicians tend to apply during practice and when on stage (Chaffin, Imreh & Crawford, 2002). Therefore, we decided to include so-called Technical, Expressive, and Emotional performance instructions, rather than asking performers to communicate distinct emotions. The first instruction was to focus on the technical aspects of playing. By this we meant aspects such as rhythm, dynamics, and articulation. The second instruction was to give an expressive performance. An expressive performance can be defined in many different ways (e.g., Juslin, 2003, 2009; Lindström et al., 2003; Sloboda, 1996, 2000; Timmers & Honing, 2002). In the present study, we left it intentionally open as to what we meant by an expressive performance. We simply asked participants "to give an expressive performance as they would normally do" without any further explanation. Following a mood induction procedure (see the Method section), the third instruction was to play while focusing on experienced emotions. We defined experienced emotions as music-related felt or induced emotions of the performer, as opposed to practice- or performance-related emotions (see Van Zijl & Sloboda, 2011) or perceived emotions (see Gabrielsson, 2001–2002). We chose sadness-inducing mood induction procedures that are in line with methods musicians tend to use when constructing an interpretation and preparing for a performance (e.g., Juslin, 2003; Persson, 2001; Persson et al., 1992; Van Zijl, 2008). We used a musical phrase that, based on its structural features, can be characterized as sad. To check whether the performers had been able to follow the instructions, performers were briefly interviewed after each playing condition.

We examined and compared the tempo, articulation, dynamics, timbre, and vibrato of the Technical, Expressive, and Emotional performances. The performance characteristics investigated are the characteristics most commonly described in the literature (e.g., Gabrielsson & Juslin, 1996; De Poli, Rodà & Vidolin, 1998; Juslin, 2000). By investigating such a wide range of characteristics, we aimed to obtain a general idea about the potential impact a performer's focus might have on a performance. We selected a limited number of audio features for the examination of each performance characteristic. The selection of audio features was largely based on the work carried out by De Poli, Rodà, and Vidolin (1998), with the main difference being that we used the MATLAB MIR Toolbox (Lartillot & Toiviainen, 2007) to extract the features. The limited set of audio features enabled us to compare the results obtained computationally against the actual performances, and ensure the reliability of the features computed. We investigated the differences between performance conditions across all participants, as well as between amateurs and professionals.

METHOD

Participants

Eight violinists (4 professionals and 4 accomplished amateurs, all female, mean age 24.3 years, SD = 1.8) participated in the study. The amateur and professional participants were similar in terms of age and years of playing, but differed in terms of years of lessons, practice hours per week, and number of performances per year. Table 1 gives an overview of the musical background of the participants.

	Amateurs		Professionals	
	Mean	SD	Mean	SD
Age	24.8	2.06	23.8	1.71
Years of playing	17.8	2.63	18	2.16
Years of lessons	12.5	5.97	17.3	2.63
Hours of practice per week	3.8	4.35	19.5	6.14
Performances per year	10.8	6.24	38.5	7.68

Table 1: Overview of participants' musical background.

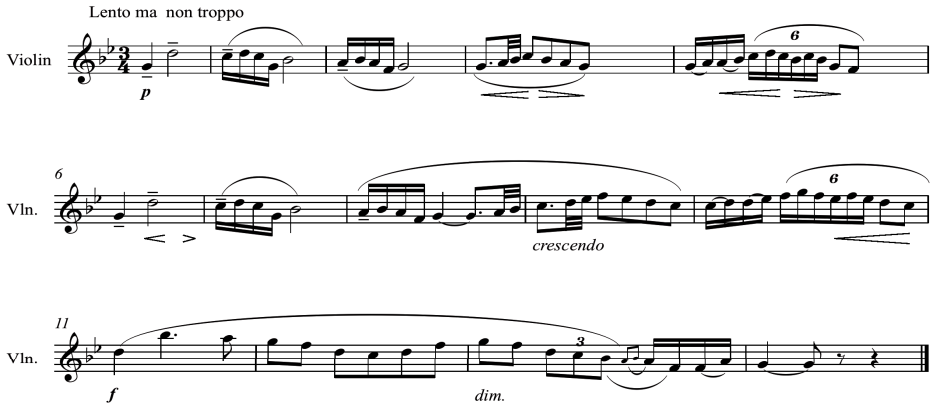

Figure 1: Musical score of the phrase composed by Sir Hamilton Harty, as used in the study.
(Copyright 1911, Stainer & Bell Ltd, 23 Gruneisen Road, London N3 1DZ England, www.stainer.co.uk)

Musical stimuli

The two musical phrases used in the study were taken from *Three miniatures for oboe and piano: Orientale, Chansonette, À la campagne* by the British composer Sir Hamilton Harty (1911). Only the solo parts were used, not the piano accompaniment. Two violinists tested the phrases beforehand, to make sure they were suitable for being played on a violin. The composer and title of the piece were removed from the score. The phrases were chosen because of their unfamiliarity, contrasting characters, and limited difficulty. In the present paper, we focus on the first 14-bar phrase taken from the movement Orientale. This phrase is in G minor, and the tempo indication is *Lento ma non troppo*. On these bases, we characterized this phrase as sad and atmospheric. Figure 1 shows the score of this phrase. The second 18-bar phrase (not shown) was taken from the movement Chansonette. This phrase is in A major, and the tempo indication is *Grazioso e con moto*. On these bases, we characterized this phrase as happy and dance-like. The second phrase was mainly included to help ensure that participants were in a positive mood at the end of the data collection procedure (see below). Participants received the sheet music of the phrases one week prior to data collection.

Apparatus

Audio recordings were made using ProTools8 software and a Microtech Gefell M300 directional microphone surrounded by an SE Electronics Reflection Filter. For reference purposes, video recordings were made with four Sony video cameras.

Materials and Procedure

To assess their current mood, participants first completed the Positive and Negative Affect Scale (PANAS) state questionnaire (Watson, Clark & Tellegen, 1988). Then, three recording sessions followed in which participants played the first ('sad') musical phrase in response to three different instructions. For each instruction, participants were encouraged to play the phrase three times.

The first instruction was: "While playing, try to focus on the technical aspects of your playing: So, think for instance about the rhythm, think about the dynamics, and think about the articulation." Following each recording session, participants were interviewed about their performances. They were asked which performance was most representative in light of the instruction given; what they thought about while playing; whether it felt natural to them to play while thinking about the instruction; and how they felt while playing.

The instruction for the second recording session was: "Play as you would normally play while giving an expressive performance." Subsequently, the same interview questions as above were asked.

Before the third recording session, participants were subjected to a two-part mood induction task. They were told that the phrase was taken from a piece of music written by a British composer shortly after he had lost his four-year-old son. Participants were asked to imagine the following scene:

> It's about 8 o'clock in the evening. The composer has just brought his little son to bed. Normally his little boy always wanted to hear a story. But this time it was

> different. This time the boy looked pale, he didn't seem to feel well, and he didn't want to hear a story. He was just afraid to be left alone. The composer was worried about him. Soon the little boy felt asleep, but he was trembling, and dreaming heavily. As soon as his wife arrived, the composer went away to call for the doctor. Finally the doctor arrived. But it was already too late. The little boy had died in the arms of his mum.

Participants were told that since the first phrase was written shortly after the composer lost his son, he might have tried to express his sadness in the music. This task was inspired by literature indicating that, when preparing a performance, musicians tend to collect background information about the composer, his/her intentions, and the period in which the piece of music was written (e.g., Juslin, 2003; Van Zijl, 2008). In addition, participants were asked to think of an intense sad experience during which they felt emotions similar to the grief and sadness of the composer. They were encouraged to imagine their experience as vividly as possible, and try to feel again how they felt during their experience. Participants either wrote a few lines about their experience, or told the experimenter about it. This task was inspired by literature reporting that musicians tend to recall emotional memories or memories of emotions to bring themselves into an appropriate mood to play a certain piece (e.g., Persson, Pratt & Robson, 1992; Persson, 2001). Subsequently, participants were asked to play the first phrase according to the following instruction: "Think about the emotional experience you've just written/spoken about. Try to feel the emotions of grief, of great sadness expressed by the music. Don't think about your playing, just focus on the emotions." Following the third recording session, participants completed the PANAS state questionnaire again, to assess whether their mood had changed after the mood induction procedure. Then, the same interview questions as listed above were asked.

After the participants had completed a questionnaire about their musical background and preparation of the musical phrases, they were debriefed: The composer of the music did not have a son, he was just happily married. To help put the participants into a positive mood again, they completed a final recording session in which they played the second ('happy') phrase, while "thinking of free movie tickets and sunshine".

When the final recording session was finished, participants were asked what they thought about the experiment; what they thought about any differences between their performances; what their best recording session was (i.e., in relation to which instruction) and why; and whether there was anything they wanted to add or ask. Finally, participants received two movie tickets and they were thanked for their participation. In total, data collection lasted about 90 minutes per participant.

Extraction of Audio Features

Prior to analyzes, all performances were manually segmented per bar, using the Sonic Visualiser software (Cannam, Landone & Sandler, 2010). Subsequently, using the MATLAB MIR Toolbox (Lartillot & Toiviainen, 2007), several audio features were extracted for (each bar of) each performance.

To investigate the tempo of the performances, we examined the performance duration in seconds, the duration of each bar in seconds, and the coefficient of variation of the bar durations.

Articulation was investigated by estimating the attack slope of each note. To detect the note onsets in performances played in a legato manner, we first computed a complete pitch curve and detected the periods of stable frequency corresponding to each note (Lartillot, 2012b). The attack slope was then estimated from the logarithm of the energy curve starting from each pitch-related note onset time, and computed as the ratio between the magnitude difference at the beginning and the ending of the attack period and the corresponding time difference.

To investigate the dynamics of the performances, we calculated the root mean square energy (RMS), both per performance and per bar, as well as the difference between the minimum and maximum RMS values of the bars of each performance. To account for differences caused by recording settings, distance to the microphone, or instrument characteristics, the RMS values were normalized to have the mean of unity across performances for each participant.

Timbre was investigated by extracting two features: The spectral centroid, a measure indicative of the geometric centre of the spectral distribution, and connected to the perception of brightness of a sound (Grey & Gordon, 1978); and roughness, a measure indicative of sensory dissonance related to the beating phenomenon whenever pairs of sinusoids are close in frequency (Plomp & Levelt, 1965). The roughness model integrated in the MIR Toolbox computes the peaks of the spectrum and takes the sum of all the dissonance values between all possible pairs of peaks (Lartillot, 2012a; Sethares, 1998). To account for differences caused by recording settings, distance to the microphone, or instrument characteristics, the spectral centroid and roughness values were normalized to have the mean of unity across performances for each participant.

To quantify the depth and rate of vibrato, we manually selected the eight longest notes of each performance and converted them into separate audio files using the audio editing software Audacity (Mazzoni & Dannenberg, 2000). Each note was then decomposed into 46.4 ms frames with a hop of 10 ms, and the fundamental frequency in each frame was estimated using the method proposed by Tolonen and Karjalainen (2000). The relative vibrato depth was determined as the standard deviation of pitch estimates for

subsequent windows divided by the fundamental frequency, while the vibrato rate was estimated by applying autocorrelation to the time series of estimated fundamental frequencies, and determining the lag that corresponds to the highest peak in the autocorrelation. To prevent erroneous pitch estimates due to resonating strings of previous or subsequent notes we extracted the depth and rate of vibrato of the middle portion (of 1 second) of each note.

Statistical Analyses

We intended to analyze 72 performances (8 participants × 3 performance conditions × 3 performances). However, one participant gave five Technical performances, another participant gave four Expressive performances, and a third participant gave only two performances per performance condition. Since we excluded the "extra" performances to obtain an equal number of performances per performance condition, 69 performances remained for analyses.[1]

Differences in tempo, articulation, and vibrato were analyzed via mixed-design ANOVAs, with performance condition and bar number or note number as within-subjects factors, expertise (amateur or professional) as between-subjects factor, and post-hoc pair-wise comparisons with Bonferroni correction for multiple comparisons. Differences in dynamics and timbre were analyzed via repeated-measures ANOVAs, with performance condition and bar number as within-subjects factors, and post-hoc pair-wise comparisons with Bonferroni correction for multiple comparisons. In case of the dynamics and timbre analyses, differences between amateurs and professionals were analyzed via independent t-tests on the non-normalized data. When Mauchly's test indicated that the assumption of sphericity had been violated, the degrees of freedom of the main ANOVAs were corrected using Greenhouse-Geisser estimates of sphericity.[2]

Qualitative Analysis

The interview questions were transcribed and subjected to Qualitative Content Analysis: A method for studying textual data that seeks to analyze texts in terms of the presence and frequency of specific terms, narratives or concepts (Tonkiss, 2004). For each question, the answers were summarized, coded, and categorized by grouping together similar descriptions.

RESULTS

The Results are presented as follows: We start with discussing the effectiveness of the mood induction procedure. Then, we address the differences in tempo, articulation, dynamics, timbre, and vibrato between the different performance conditions, across all participants, as well as between the amateur and professional performers. Finally, we present the findings of the qualitative analysis of the interview data.

Mood Induction Procedure

The effectiveness of the mood induction procedure was examined via the PANAS state questionnaire, administered before and after the mood induction procedure took place, as well as via interview questions. Although 5 out of 8 participants showed a decrease in their positive PANAS score, and 5 out of 8 participants showed an increase in their negative PANAS score when comparing the pre and post measurements, the dependent t-test did not reach significance, $t(7) = 0.289$, $p > .05$. In the interviews, all participants indicated that the mood induction procedure made them feel sad. Interestingly, however, this was not necessarily seen as something negative. In the words of one participant: "… now I had something to tell through the music, not just the notes". In the words of another:

> My feelings changed into the sad direction. Being sad. But they also changed to the positive, because afterwards I got like.. the feelings came closer to me, every feeling. So through this sad experience, sad emotion, also my good feelings came to the top more. (…) Now I got more exhausted and more enthusiastic, and eager to play. Especially in the beginning, when I started this third session I felt really good and I loved playing. I knew again why I play, why I'm playing the violin. It felt good.

Overall, the mood induction procedure seemed to work well. Important though, is to acknowledge the special characteristic of music-related emotions: Experiencing sad emotions and expressing them through music can be viewed as something positive.

Tempo

A mixed-design ANOVA with performance condition as within-subjects factor and expertise as between-subjects factor revealed a significant main effect of performance condition on performance duration, $F(1.57, 33.01) = 15.76$, $p < .001$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Emotional ($p < .01$) and between the Expressive and Emotional performances ($p < .001$) only. The performances of the professionals were much shorter than the performances of the amateurs, $F(1, 21) = 10.71$, $p < .01$. The interaction between performance condition and expertise was non-significant.

When performing the analysis at the bar level rather than on complete performances, a mixed-design ANOVA with performance condition and bar number as within-subjects factors and expertise as between-subjects factor revealed significant main effects of performance condition on bar duration, $F(1.57, 33.01) = 15.76$, $p < .001$,

and bar number on bar duration, $F(3.27, 68.71) = 37.78$, $p < .001$. In addition, significant interactions were found between bar number and expertise, $F(3.27, 68.71) = 4.27$, $p < .01$, and between performance condition and bar number, $F(6.75, 141.64) = 4.00$, $p < .001$.

Figure 2 shows the average duration of each musical bar in the three performance conditions. As can be seen, the Emotional performances were played slower than the Technical and Expressive ones. Performers particularly slowed down in bars 5, 10, and 13 – which might be explained by the large number of short notes in these bars, and by the musical function of these bars: These bars form the end of a musical line within the phrase.

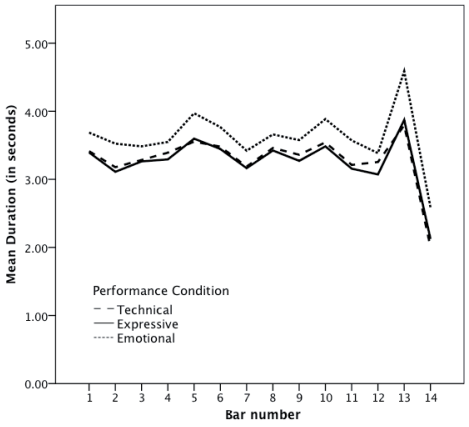

Figure 2: Mean bar duration, per performance condition, across all performers.

To examine the fluctuation in tempo, we calculated the coefficient of variation of the bar durations. A mixed-design ANOVA with performance condition as within-subjects factor and expertise as between-subjects factor revealed that the main effect of performance condition on tempo fluctuation was non-significant. The interaction between performance condition and expertise was significant, $F(2, 42) = 5.26$, $p < .01$. The tempo of the amateurs fluctuated significantly more than the tempo of the professionals, $F(1, 21) = 11.77$, $p < .01$.

Articulation

A mixed-design ANOVA with performance condition as within-subjects factor and expertise as between-subjects factor revealed a significant main effect of performance condition on attack slope, $F(1.42, 29.85) = 9.72$, $p < .01$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive ($p < .01$), and Expressive and Emotional performances ($p < .01$) only. The performances of the professionals were associated with a significantly higher attack slope value than the performances of the amateurs, $F(1, 21) = 7.64$, $p < .05$. The interaction between performance condition and expertise was non-significant.

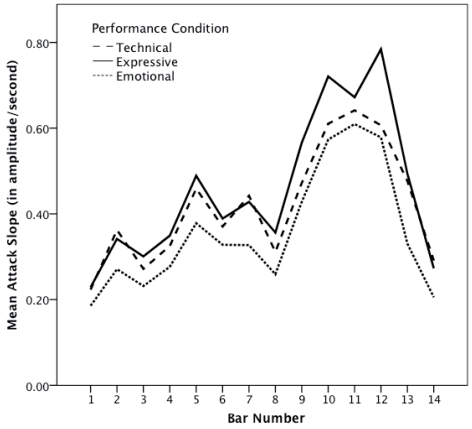

Figure 3: Mean attack slope values per bar, per performance condition, across all performers.

Figure 3 shows the average attack slope values per musical bar. As can be seen, the Technical and Expressive performances are relatively similar over the first eight bars, whereas the Emotional performances are played with a less rapid note attack. In the last six bars, the Technical and Emotional performances are relatively similar, whereas the Expressive performances are played with a rapid note attack.

When performing the analysis at the bar level rather than on complete performances, a mixed-design ANOVA with performance condition and bar number as within-subjects factors and expertise as between-subjects factor revealed significant main effects of performance condition on attack slope, $F(1.37, 28.80) = 13.97$, $p < .001$, and bar number on attack slope, $F(3.10, 65.18) = 33.99$, $p < .001$. In addition, significant interactions were found between bar number and expertise, $F(3.10, 65.18) = 5.13$, $p < .01$, and between performance condition and bar number, $F(10.30, 216.20) = 2.24$, $p < .05$.

Dynamics

A repeated measures ANOVA with performance condition as within-subjects factor revealed a significant main effect of performance condition on the normalized mean RMS,

$F(1.40, 30.72) = 11.53$, $p < .01$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive ($p < .01$), and Expressive and Emotional performances ($p < .01$) only. An independent t-test on the non-normalized data revealed that the performances of the professionals were associated with a higher RMS value than the performances of the amateurs, $t(67) = -5.47$, $p < .001$.

When performing the analysis at the bar level rather than on complete performances, a repeated-measures ANOVA with performance condition and bar number as within-subjects factors revealed a significant main effect of performance condition on the normalized mean RMS, $F(1.35, 29.69) = 11.32$, $p < .01$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive ($p < .01$), and Expressive and Emotional performances ($p < .01$), as well as a significant main effect of bar number on RMS value, $F(3.39, 74.62) = 67.88$, $p < .001$, and a significant interaction between performance condition and bar number, $F(7.49, 164.77) = 3.22$, $p < .01$.

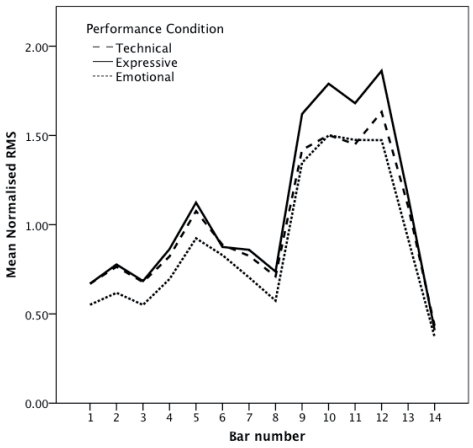

Figure 4: Mean normalized RMS values per bar, per performance condition, across all performers.

Figure 4 shows the average normalized RMS values per musical bar. As can be seen, the dynamics indicated in the score (see Figure 1) are followed: Piano in the beginning, crescendo from bar 8 leading to a forte part, and a diminuendo towards the end. The Technical and Expressive performances are very similar in dynamics over the first eight bars, whereas the Emotional performances are played softer. In the last six bars, the Technical and Emotional performances are relatively similar, whereas the Expressive performances are played louder. In bar 11 we notice a decrease in RMS value in the Expressive and Technical performances. Examination of the videos revealed that this decrease might be explained by the bowing used: In case the B-flat is played with an up-bow stroke the sound tends to be softer.

To examine the dynamic range of the performances, we calculated the difference between the minimum and maximum normalized RMS values of the bars of a performance. A repeated-measures ANOVA with performance condition as within-subjects factor revealed a significant main effect of performance condition on dynamic range, $F(2, 44) = 9.16$, $p < .001$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive ($p < .001$), and Expressive and Emotional performances ($p < .05$) only. An independent t-test on the non-normalized RMS values revealed that the dynamic range used by the professionals was significantly larger than the dynamic range used by the amateurs, $t(67) = -5.87$, $p < .001$.

Timbre

A repeated-measures ANOVA with performance condition as within-subjects factor revealed that the main effect of performance condition on the normalized mean spectral centroid values was non-significant. In addition, an independent t-test on the non-normalized values revealed that the difference between the performances of the professionals and amateurs was non-significant.

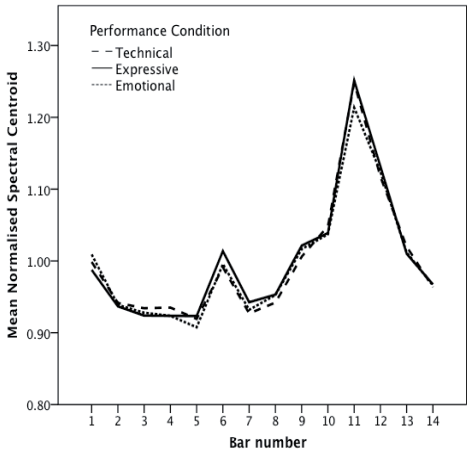

Figure 5: Mean normalized spectral centroid values per bar, per performance condition, across all performers.

When performing the analysis at the bar level rather than on complete performances, a repeated-measures ANOVA with performance condition and bar number as within-subjects factors revealed a significant main effect of bar number on the normalized mean spectral centroid, $F(3.96, 87.12) = 110.54$, $p < .001$ (which can be explained by the different notes being played in different bars, see Figure 5). The main effect of performance condition on the normalized mean spectral centroid, and interaction between performance condition and bar number were non-significant.

A repeated-measures ANOVA with performance condition as within-subjects factor revealed a significant main effect of performance condition on the normalized roughness values, $F(1.58, 34.81) = 4.13$, $p < .05$, although the differences between specific performance conditions did not reach significance in the post-hoc pair-wise comparisons. An independent t-test on the non-normalized values revealed that the performances of the professionals were associated with a significantly higher roughness value than the performances of the amateurs, $t(33.46) = -4.18$, $p < .001$.

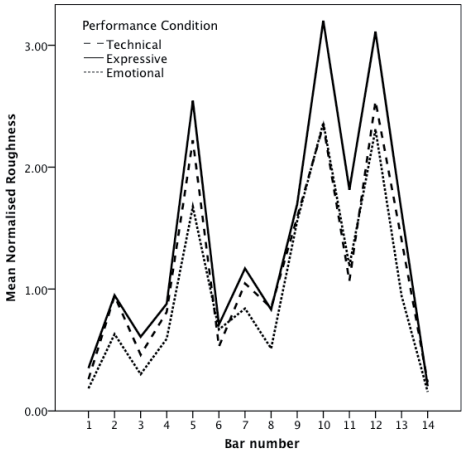

Figure 6: Mean normalized roughness values per bar, per performance condition, across all performers.

When performing the analysis at the bar level rather than on complete performances, a repeated-measures ANOVA with performance condition and bar number as within-subjects factors revealed a significant main effect of performance condition on the normalized roughness values, $F(1.45, 31.85) = p < .01$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive ($p < .05$) and Expressive and Emotional performances ($p < .05$), as well as a significant main effect of bar number on normalized roughness, $F(4.22, 92.87) = 31.50$, $p < .001$. The interaction between performance condition and bar number was non-significant.

As can be seen in Figure 6, the Technical and Expressive performances were relatively similar in the first eight bars, whereas in the last six bars the Technical and Emotional performances were more similar. It is interesting to note that we saw a similar pattern in case of the RMS data (see Figure 4) and attack slope data (see Figure 3). The Pearson's correlation coefficient revealed high correlations between the normalized mean RMS and normalized roughness values, $r = .87$, $p < .001$, between the normalized mean RMS and attack slope values, $r = .50$, $p < .001$, and between the normalized roughness and attack slope values, $r = .48$, $p < .001$. It is likely that articulation, dynamics and timbre are all affected by the bowing technique used: The bow speed, bow-pressure, and distance from the bridge affect the intensity, attack, and timbre of the sound (Gelre, 1991).

Vibrato

A mixed-design ANOVA with performance condition as within-subjects factor and expertise as between-subjects factor revealed a significant main effect of performance condition on the relative vibrato depth, $F(2, 42) = 9.22$, $p < .001$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive ($p < .05$), and Expressive and Emotional performances ($p < .001$) only. The interaction between performance condition and expertise was non-significant. The amateurs used a slightly wider vibrato (or their intonation was slightly less precise) than the professionals. The difference, however, was not statistically significant.

When performing the analysis at the note level rather than on complete performances, a mixed-design ANOVA with performance condition and note number as within-subjects factors and expertise as between-subjects factor revealed a significant main effect of performance condition on the relative vibrato depth, $F(2, 42) = 9.22$, $p < .001$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive ($p < .05$), and Expressive and Emotional performances ($p < .001$), as well as a significant main effect of note number on vibrato depth, $F(3.60, 75.53) = 5.65$, $p < .001$. The interactions between performance condition and expertise, note number and expertise, performance condition and note number, and performance condition, note number and expertise were non-significant.

As can be seen in Figure 7, showing the relative vibrato depth per performance condition of the eight longest notes, performers used a slightly wider vibrato in the Expressive condition as compared to the Emotional and Technical ones. To examine the variation in relative vibrato depth, we

calculated the coefficient of variation of the eight longest notes. A mixed-design ANOVA with performance condition as within-subjects factor and expertise as between-subjects factor revealed that neither the main effect of performance condition on variation in vibrato depth, nor the interaction between performance condition and expertise were significant. The professionals, however, varied their vibrato depth significantly more than the amateurs, $F(1, 21) = 5.92$, $p < .05$.

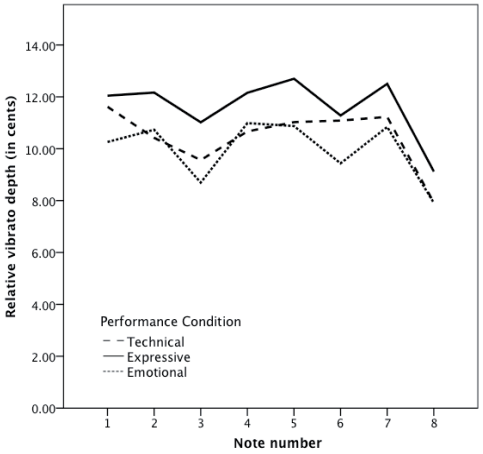

Figure 7: Mean relative vibrato depth of the eight longest notes, per performance condition, across all performers.

A mixed-design ANOVA with performance condition as within-subjects factor and expertise as between-subjects factor revealed a significant main effect of performance condition on vibrato rate, $F(2, 42) = 5.54$, $p < 0.01$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive ($p < 0.05$) and Expressive and Emotional ($p < 0.05$) performances only. The interaction between performance condition and expertise was non-significant. The vibrato of the professionals was significantly faster than the vibrato of the amateurs, $F(1, 21) = 6.05$, $p < 0.05$.

When performing the analysis at the note level rather than on complete performances, a mixed-design ANOVA with performance condition and note number as within-subjects factors and expertise as between-subjects factor revealed a significant main effect of performance condition on vibrato rate, $F(2, 42) = 5.54$, $p < 0.01$, with post-hoc pair-wise comparisons indicating significant differences between the Technical and Expressive ($p < 0.01$) and Expressive and Emotional ($p = 0.05$) performances only. Neither the main effect of note number on vibrato rate, nor the interactions between performance condition and expertise, note number and expertise, performance condition and note number, and performance condition, note number and expertise were significant.

As can be seen in Figure 8, showing the average vibrato rate per performance condition of the eight longest notes, performers used a slightly faster vibrato in the Expressive condition as compared to the Emotional and Technical ones. To some extent, this might be explained by the playing tempo: Performers played fastest in the Expressive performances. It could be that they adjusted their use of vibrato accordingly. In the Expressive and Emotional performances, the performers used the fastest vibrato on the B-flat in bar 11 (Note 7 in Figure 8), the highest note of the phrase. A relatively wide and fast vibrato seems to be used to emphasize this note.

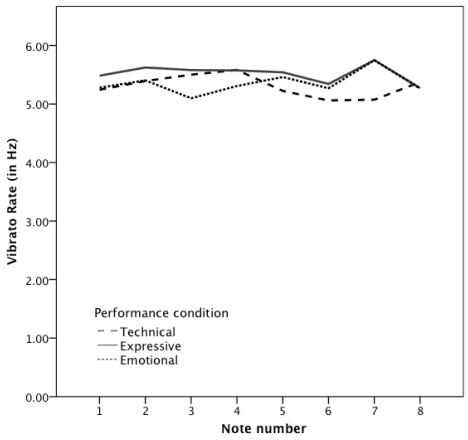

Figure 8: Mean vibrato rate of the eight longest notes, per performance condition, across all performers.

To examine the variation in vibrato rate, we calculated the coefficient of variation of the eight longest notes. A mixed-design ANOVA with performance condition as within-subjects factor and expertise as between-subjects factor revealed a significant main effect of performance condition on variation in vibrato rate, $F(2, 42) = 4.77$, $p < .05$, with post-hoc pair-wise comparisons indicating a significant difference between the Technical and Expressive performances ($p < .05$) only. The interaction between performance condition and expertise was non-significant. The professionals varied their vibrato rate slightly more than the amateurs. The difference, however, was not statistically significant.

Interviews

Qualitative Content Analysis of the interview transcripts offered insights into the performers' perspective: What did they think about while playing? How did they feel? How well were they able to follow the instructions?

After the Technical performances, all participants indicated that they had been thinking about the technical aspects of playing. Although this felt natural to all participants, four participants pointed out that technique is only one level: "It's very difficult to think just about the technical aspects while playing, because it's so natural for a musician to think about many things at the same time, musical and technical." When asked how they felt while playing, most participants answered in general terms such as "quite good", "pretty neutral", and "just well". In addition to these mood descriptors, all participants reflected on how well they played. None of the participants experienced any emotions in relation to the music.

After the Expressive performances, all participants indicated that they had been focusing on the music. Some participants referred to the score: "I was thinking about the music, the phrases. Where is the strongest point? Where does the first phrase start and where the second kind of voice?" Others emphasized the importance of listening: "I just tried to listen very carefully to what I play, and like… all the time trying to figure out how it should sound, how to get everything out of every note, how to get meaning to everything." Two participants explicitly indicated that they had been imagining an audience: "I thought that there was an audience and that I was alone on the stage, playing." When asked how they felt while playing, four participants explicitly described feelings they experienced in relation to the music: "Mysterious, that is the word. While I play, I think this feeling comes out of the phrase which I sort of interpret… and play out… and feel." The other four participants described their feelings again via general mood descriptors such as "just fine".

After the Emotional performances, all participants indicated that they had been thinking about emotional memories and/or the story about the composer. Five participants indicated that they felt more comfortable and calm during the Emotional performances, which might have been related to their tendency "to forget about technical things". Three participants elaborated on how their memories were related to their playing, how it was "like an expression of something inside". In the words of one of them: "I was thinking about crying, about blackness, about sadness. (…) And then I got a feeling here [points towards her breast]. I was just feeling that, just physically listening to my body. So I felt it here… it was about breathing too, like, how it is when you cry, the shivering of the body." In the words of another: "Well… it's like, as a human being, whatever you can give to another person. That's all I could give."

At the end of the experiment, participants were asked to reflect on their performances. Two participants rated their Expressive performances as their best, and six participants their Emotional performances. An important aspect explicitly mentioned by five participants was that although they rated their Emotional performances as their best, they were not sure about the actual quality of them: "If I'm not thinking about the technical aspects I can imagine 'this sounds really good', but if the others, outside, say that it doesn't sound so good because I didn't think about my fingers for instance… like, it can lie a bit, if I'm in those emotions and stories… that in fact it doesn't sound so good."

SYMMARY AND DISCUSSION

What is the effect of performers' experienced emotions on the auditory characteristics of their performances? By asking performers to play a musical phrase in response to three different instructions – focus on technique; focus on expressivity; focus on experienced emotions – we attempted to answer this question. We analyzed the tempo, articulation, dynamics, timbre, and vibrato of the performances obtained, as well as interview data. We found that the emotions experienced by performers affected the auditory characteristics of their performances. As summarized in Table 2, each performance condition revealed a different pattern of auditory characteristics.

The auditory characteristics of the Technical performances often resembled the characteristics of one of the other conditions, as displayed in the Figures. In the case of tempo (i.e., average performance duration), the Technical performances were played almost as fast as the Expressive performances. In the case of articulation (i.e., attack slope), dynamics (i.e., mean RMS), and timbre (i.e., mean roughness), the Technical performances resembled the Expressive performances during the first eight bars of the phrase, and the Emotional performances during the last six bars. The dynamic range (i.e., the difference between the minimum and maximum RMS) was smallest in the Technical performances, whereas the relative vibrato depth was average and the vibrato rate lowest as compared to the other conditions. In the Technical performances, it seemed that the performers were just playing the notes as written, without adding much personal expression to the music. In the interviews, most performers indicated that it felt natural to focus on technique: "When you are studying music, that's the first thing to focus on." Some performers, however, felt a bit inhibited: "Maybe it restricted me a bit, because I wasn't sure if I could express like any emotions." None of the performers rated their Technical performances as their best.

	Tempo		Articulation	Dynamics		Timbre		Vibrato	
	Mean performance duration (in seconds)	Mean fluctuation in bar duration (coefficient of variation)	Mean attack slope (in amplitude/s)	Mean RMS (normalized)	Dynamic range (difference between minimum & maximum normalized RMS)	Mean spectral centroid (normalized)	Mean roughness (normalized)	Relative vibrato depth (in cents)	Vibrato rate (in Hz)
Technical	*M* = 46.12 SD = 11.67	*M* = 0.142 SD = 0.035	*M* = 0.35 SD = 0.11	*M* =1.011 SD = 0.097	*M* = 1.37 SD = 0.27	*M* = 1.0002 SD = 0.015	*M* = 1.00 SD = 0.21	*M* = 10.44 SD = 4.07	*M* = 5.31 SD = 0.34
Expressive	*M* = 45.67 SD = 9.57	*M* = 0.148 SD = 0.028	*M* = 0.39 SD = 0.12	*M* = 1.088 SD = 0.099	*M* = 1.72 SD = 0.30	*M* = 1.0015 SD = 0.016	*M* = 1.15 SD = 0.33	*M* = 11.62 SD = 4.85	*M* = 5.52 SD = 0.35
Emotional	*M* = 50.66 SD = 9.81	*M* = 0.151 SD = 0.041	*M* = 0.31 SD = 0.07	*M* = 0.901 SD = 0.140	*M* = 1.44 SD = 0.49	*M* = 0.9983 SD = 0.018	*M* = 0.85 SD = 0.35	*M* = 9.97 SD = 4.30	*M* = 5.35 SD = 0.46

Table 2: Overview of the mean values and standard deviations of the main auditory characteristics investigated.

The Expressive performances were generally characterized by the highest values of the auditory characteristics investigated. As compared to the Emotional performances in particular, the Expressive performances were characterized by a faster tempo, a louder sound, the largest dynamic range, a more rough timbre, rapid note attacks, and a relatively wide and fast vibrato. In the interviews, several performers indicated that during the Expressive performances they imagined being on stage, playing in front of an audience. According to one of the performers: "When I was thinking that there was an audience [the Expressive condition] I played bigger and... I played to someone, not to myself like I played the last and the first ones." The interview data suggest that in the Expressive performances performers were focused on bringing the musical message across towards an (imaginary) audience. The auditory performance characteristics suggest that this resulted in more extraverted playing. Two out of eight performers rated their Expressive performances as their best.

The Emotional performances were generally characterized by the lowest values of the auditory characteristics investigated. The Emotional performances were played more slowly, with a less rough timbre, and less rapid note attacks, as compared to the Technical and Expressive performances. In case of dynamics and vibrato, the Emotional performances were played more softly, with a smaller dynamic range, and a less wide and slower vibrato than the Expressive performances, but with a larger dynamic range and slightly faster vibrato than the Technical performances. In the interviews, all performers indicated that it felt natural to focus on their emotions, although one performer indicated: "It was a little bit unnatural, because I don't know you people, and then suddenly… get every feeling in me, and in the music. That's what I want to do in my profession, of course, but it's very strong (…) it's a very strong emotion and you give very much of yourself." The interview data suggest that the performers were focused on their own emotions and feelings towards the music. The auditory performance characteristics suggest that this resulted in more introverted playing. Although six out of eight performers rated their Emotional performances as their best, several of them indicated that experiencing strong emotions while playing might distort their perception of the quality. In the words of one of the performers: "… it can lie a little bit, if I'm in those emotions and stories… that in fact it doesn't sound so good."

Differences were also found between the performances of the amateur and professional performers, as summarized in Table 3. The amateurs played slower, softer, with less rapid note attacks, a less rough timbre, and a wider and slower vibrato, as compared to the professionals. We might explain these differences in auditory performance characteristics by differences in level of expertise. The amateurs might have chosen to play the phrase in a slower tempo to make sure they could cope with the technical demands of the phrase. The vibrato might have been adjusted to the slower playing tempo. The softer dynamics, differences in timbre, and less rapid note attacks might have been related to the bowing technique used. The bow speed, bow-pressure, and distance from the bridge, for instance, affect the intensity and timbre of the sound. A higher bow speed (while keeping the bow-pressure and distance constant) results in a more intense sound, but requires a higher level of expertise (Gelre, 1991). The shaping of the individual notes, likewise, is related to bow control, something that increases when expertise develops.

	Tempo		Articulation	Dynamics		Timbre		Vibrato	
	Mean performance duration (in seconds)	Mean fluctuation in bar duration (coefficient of variation)	Mean attack slope (in amplitude/s)	Mean RMS (normalized)	Dynamic range (difference between minimum & maximum normalized RMS)	Mean spectral centroid (normalized)	Mean roughness (normalized)	Relative vibrato depth (in cents)	Vibrato rate (in Hz)
Amateurs	*M* = 52.94 SD = 9.61	*M* = 0.163 SD = 0.030	*M* = 0.31 SD = 0.08	*M* = 0.027 SD = 0.006	*M* = 0.06 SD = 0.04	*M* = 2641.05 SD = 198.22	*M* = 2.08 SD = 1.42	*M* = 10.89 SD = 3.89	*M* = 5.24 SD = 0.42
Professionals	*M* = 41.53 SD = 7.92	*M* = 0.130 SD = 0.031	*M* = 0.40 SD = 0.11	*M* = 0.035 SD = 0.006	*M* = 0.09 SD = 0.06	*M* = 2591.83 SD = 25.51	*M* = 4.38 SD = 2.43	*M* = 10.45 SD = 4.97	*M* = 5.56 SD = 0.28

Table 3: Overview of the mean values and standard deviations of the main auditory characteristics of the amateur and professional performances.

The findings of the present study suggest that the experienced emotions of performers not only affect their movements (Van Zijl & Luck, 2013a), but also the auditory characteristics of the performances. It is of interest to note that the movement and auditory patterns are related in a meaningful way. As indicated above, for instance, the Expressive performances were characterized by the fastest playing tempo, the loudest sound, a rough timbre, rapid note attacks, and a wide and fast vibrato, as well as the highest amount, speed, acceleration, and lowest smoothness of performers' movements. The Emotional performances, in contrast, were characterized by the slowest playing tempo, the softest sound, a less rough timbre, the least rapid note attacks, and a narrow and moderately fast vibrato, as well as a moderate amount, low speed, low acceleration, and highest smoothness of performers' movements. As indicated above, it is likely that dynamics, articulation, and differences in timbre are related to the bowing technique used. The finding that performers' bow speed and acceleration were highest in the Expressive performances and lowest in the Emotional performances supports this explanation.

In addition, the findings support the preliminary findings by Higuchi et al. (2010) and Glowinsky et al. (2008): Performers played with less rapid note attacks in the Emotional performances, and differences were found in the duration of the performances in different conditions. Important to note, however, is that we only looked at performances of a sad phrase. In the case of sadness, we found that performers displayed more extraverted playing when expressing the music, and more introverted playing while feeling the music. In the case of an emotion such as anger, one may well find different results.

When comparing the findings of the present study to the acoustic characteristics associated with the musical expression of sadness as mentioned above (Juslin, 2009), we see many similarities. Interesting to note is that when comparing the Technical, Expressive, and Emotional performances, the auditory characteristics of the Emotional performances seem to be most representative of the features associated with the expression of sadness, such as a slow tempo, low sound level, dull timbre, slow note attacks, and a slow and narrow vibrato. In this regard, our findings contrast with some of the findings by Erickson et al. (2006) regarding the vocal expression of emotions. Erickson et al. found that imitated sad speech more strongly followed existing stereotypes of what constitutes sad speech, and that imitated sad speech received higher ratings of sadness than spontaneous sad speech. That we did not find the Expressive performances to be most representative of features associated with sadness might be due to our focus on Technical, Expressive, and Emotional performance instructions, rather than asking performers to communicate distinct emotions. In the case of our data, it is likely that listeners would rate the Emotional performances as most representative of sadness – which is indeed what we found in a related perception study (see Van Zijl & Luck, 2013b).

Perhaps more interesting than the question of which performances sound most sad, is the question posed by Gabrielsson (2001-2002) of how performing artists best achieve a convincing expression. Should they feel the emotions perceived in the music; or rather rely on the use of appropriate technical means such as tempo, dynamics, articulation, and timbre; or perhaps adopt an intermediate position and "strive for emotional identification but still have some conscious control of performance" (p. 138)? The interview data suggest that a focus on either technique, expressivity, or experienced emotions might be somewhat artificial for a musician: "… it's so natural for a musician to think about many things at the same time, musical and technical". Six out of eight performers rated their Emotional performances as their best, but several of them expressed their concerns about the actual quality of their playing: "… it can lie a little bit, if I'm in those emotions

and stories… that in fact it doesn't sound so good." Based on the interview data, it can be concluded that performers tend to adopt an intermediate position when it comes to experiencing music-related emotions and relying on the technical use of appropriate musical means. The audio data suggest that, in case of a 'sad' piece of music, a focus on technique leads to a technically appropriate performance, a focus on expressivity to a more extraverted and externally projected performance, and a focus on felt emotion to a more introverted and personal performance. Based on the audio data, it can be concluded that a focus on either technique, expressivity, or experienced emotions results in different performances. As such, these findings are valuable for the practice and pedagogy of music performance: Performing musicians may employ a certain performance focus to achieve the intended performance expression.

Some limitations of the present study should be acknowledged – such as the small sample size, the limited differentiation between amateurs and professionals, and the non-randomization of playing conditions to ensure that the Technical and Expressive condition were not affected by the mood induction task. In particular, the non-randomization of the playing conditions could be regarded as problematic. It could be argued that the performers might have become more comfortable, or perhaps bored, by playing the piece several times. However, the fact that the playing tempo, dynamics, articulatory features such as the attack slope, timbral features such as roughness, and depth and rate of vibrato increased from the first to second recording session but decreased from the second to third session suggests that the effects reported here are not mere order effects.

To conclude, the findings are significant in several regards and give ground for further studies. First, the research design employed to study the effect of performers' felt emotions on auditory performance characteristics proved to be effective. Future research should further investigate the characteristics of performances given while focusing on different aspects of playing. It would be of interest to examine different instrumentalists, different musical phrases, and different musical genres. Second, the findings reveal that the different positions proposed by Gabrielsson (2001-2002) are not merely a matter of a performer's preference, but also have an effect on performance characteristics. This insight is valuable for the practice and pedagogy of music performance: It may help performing musicians to achieve their intended performance expression. Future research should examine the effect of performers' focus on audience perception, preferably in a live concert setting. Third, the findings reveal that performers exhibit the auditory characteristics associated with sadness (Juslin, 2009) more strongly when they focus on felt emotion as compared to when they focus on technique or expressivity. This finding contributes to the debate as to whether felt and portrayed expressions of emotion result in similar expressions (e.g., Banse & Scherer, 1996). The present results suggest that felt and expressed emotions in music result in different expressions. Future studies should test whether these patterns are bound to the expression of sadness, or whether they hold for other emotions as well. Finally, the findings provide empirical support for the distinction between emotional and expressive playing as proposed by Van Zijl and Sloboda (2011). Future research should investigate the performers' perspective in more detail in order to gain a deeper insight into the role performers' experienced emotions play in generating an expressive performance.

AUTHOR NOTE

We would like to thank the musicians who provided the performance stimuli, and Stephen McAdams and three anonymous reviewers for their valuable comments. The research reported here was supported by the Academy of Finland (project number 7118616).

Correspondence regarding this article should be addressed to Anemone G. W. Van Zijl, Department of Music, University of Jyväskylä, PO Box 35(M), 40014, Jyväskylä, Finland. Email: anemone.vanzijl@jyu.fi

FOOT NOTES

1. From a statistical point of view, it is problematic that each performer contributed several performances in each performance condition: We therefore cannot guarantee the independence of all performances included in the analyses. To verify the results described in the Results section, we performed additional non-parametric Friedman's ANOVAs as well as post-hoc Wilcoxon signed ranks tests with a Bonferroni correction to account for multiple testing (which reduces the accepted significance level to $.05/3 = p < .0167$) on one third of the data (i.e., the first Technical, Expressive, and Emotional performance each performer gave). The results of the non-parametric tests of the main analyses are presented in Appendix A.

2. The epsilon values of the Greenhouse-Geisser corrected degrees of freedom ranged from .698 to .786 for the analyses of complete performances (lower-bound .500); from .220 to .305 for the analyses at the bar level (lower-bound .077); and from .348 to .524 for the analyses at the note level (lower-bound .143).

REFERENCES

Bachorowski, J. A. & Owren, M. J. (2003). Sounds of Emotion. Production and Perception of Affect-Related Vocal Acoustics. *Annals of the New York Academy of Sciences, 1000*, 244-265.

Banse, R., & Scherer, K. R. (1996). Acoustic profiles in vocal emotion expression. *Journal of Personality and Social Psychology, 70 (3),* 614-636.

Cannam, C., Landone, C. & Sandler, M. (2010). Sonic Visualiser: An Open Source Application for Viewing, Analysing, and Annotating Music Audio Files. In Del Bimbo, A., Chang, S. & Smeulders, A. (Eds.), *Proceedings of the ACM Multimedia 2010 International Conference,* (pp. 1467-1468). New York: Association for Computer Machinery.

Chaffin. R., Imreh, G. & Crawford, M. (2002). *Practicing Perfection: Memory and Piano Performance.* Mahweh/ New Jersey/ London: Lawrence Erlbaum Associates.

Chaffin, R., Lemieux, A., & Chen, C. (2007). "It's different each time I play": Spontaneity in highly prepared musical performance. *Music Perception, 24*, 455-472.

Crane, E. & Gross, M. (2007). Motion Capture and Emotion: Affect Detection in Whole Body Movement. Recognising Human Emotions from Body Movement and Gesture Dynamics. In A. Paiva, R. Prada & R. W. Picard (Eds.), *Affective Computing and Intelligent Interaction, Lecture Notes in Computer Science, Vol. 4738,* (pp. 95-101). Berlin: Springer-Verlag.

De Poli, G., Rodà, A. & Vidolin, A. (1998). Note by note analysis of the influence of expressive intentions and musical structure in violin performance. *Journal of New Music Research, 27 (3),* 293-321.

Eerola, T. & Vuoskoski, J. K. (2013). A review of music and emotion studies: Approaches, emotion models and stimuli. *Music Perception, 30 (3),* 307-340.

Erickson, D., Yoshida, K., Menezes, C., Fujino, A., Mochida, T., and Shibuya, Y. (2006). Exploratory study of some acoustic and articulatory characteristics of sad speech. *Phonetica, 63 (1)*, 1-25.

Gabrielsson, A. (2001-2002). Emotion perceived and emotion felt: same or different? *Musicae Scientiae, special issue,* 123-147.

Gabrielsson, A. & Juslin, P.N. (1996). Emotional Expression in Music Performance: Between the Performer's Intention and the Listener's Experience. *Psychology of Music, 24*, 68-91.

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

Gerle, R. (1991). *The art of bowing practice. The expressive bow technique*. London: Stainer & Bell.

Glowinsky, D., Camurri, A., Volpe, G., Chiarra, N., Cowie, R., McMahon, E., Jaimovich, J., & Knapp, R. B. (2008). Using induction and multimodal assessment to understand the role of emotion in musical performance. In Peter et al., (Eds.) *Proceedings of the workshop Emotion in HCI – Designing for People.* (pp. 8-12). Fraunhof: Fraunhofer Verlag.

Grey, J. M. & Gordon, J. W. (1978). Perceptual effects of spectral modifications on musical timbres. *Journal of the Acoustical Society of America 63 (5),* 1493–1500.

Harty, H. (1911). *Three miniatures for oboe and piano: Orientale, Chansonette, À la campagne*. [Music score]. London: Stainer & Bell.

Higuchi, M. K. K., Fornari, J. E., & Leite, J. P. (2010). The influence of cognition and emotion in pianistic performance. In S. M. Demorest, S. J. Morrison & P. S. Campbell (Eds.), *Proceedings of the 11th International Conference on Music Perception and Cognition (ICMPC11)*. (pp. 186-191). Seattle. Washington. USA.

Juslin, P. N. (2000). Cue Utilization in Communication of Emotion in Music Performance: Relating Performance to Perception. *Journal of Experimental Psychology: Human Perception and Performance, 26 (6),* 1797-1813.

Juslin, P. N. (2003). Five Facets of Musical Expression: A Psychologist's Perspective on Music Performance. *Psychology of Music, 31 (3)*, 273-302.

Juslin, P. (2009). Emotion in music performance. In: S. Hallam, I. Cross & M. Thaut (Eds.), *The Oxford Handbook of Music Psychology.* (pp. 377-400). Oxford: Oxford University Press.

Juslin, P. N. & Laukka, P. (2003). Communication of Emotions in Vocal Expression and Music Performance: Different Channels, Same Code? *Psychological Bulletin, 129 (5),* 770-814.

Karlsson, J. & Juslin, P. N. (2008). Musical Expression: an observational study of instrumental teaching. *Psychology of Music, 36 (3),* 309-334.

Lartillot, O. (2012a). MIR Toolbox Manual [Instruction Manual]. Retrieved from http://www.jyu.fi/music/coe/materials/mirtoolbox

Lartillot, O. (2012b). Computational analysis of maqam music: From audio transcription to musicological analysis, everything is tightly intertwined. In *Proceedings of the Acoustics 2012 Hong Kong Conference.*

Lartillot, O. & Toiviainen, P. (2007). A MATLAB toolbox for musical feature extraction from audio. In *Proceedings of the 10th International Conference on Digital Audio Effects (DAFx-07),* Bordeaux, France, September 10-15.

Lindström, E., Juslin, P. N., Bresin, R., & Williamon, A. (2003). "Expressivity comes from within your soul": A questionnaire study of music students' perspectives on expressivity. *Research Studies in Music Education, 20,* 23-47.

Mazzoni, D. & Dannenberg, R. (2000). Audacity [Audio Editing and Recording Software]. Retrieved from http://audacity.sourceforge.net/

Persson, R. S., Pratt, G., & Robson, C. (1992). Motivational and Influential Components of Musical Performance: A Qualitative Analysis. *European Journal for High Ability, 3,* 206-217.

Persson, R. S. (2001). The Subjective World of the Performer. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and Emotion. Theory and Research* (pp. 275-289). Oxford: Oxford University Press.

Plomp, R. & Levelt, W. J. M. (1965). Tonal Consonance and Critical Bandwidth. *Journal of the Acoustical Society of America, 38 (4),* 548-560.

Sethares, W. A. (1998). *Tuning, Timbre, Spectrum, Scale.* London: Springer-Verlag.

Sloboda, J. A. (1996). The Acquisition of Musical Performance Expertise: Deconstructing the 'Talent' Account of Individual Differences in Musical Expressivity. In K. A. Ericsson (Ed.), *The Road to Excellence. The Acquisition of Expert performance in the Arts and Sciences, Sports and Games.* Mahweh/ New Yersey: Lawrence Erlbaum Associates.

Sloboda, J. A. (2000). Individual differences in music performance. *Trends in Cognitive Sciences, 4 (10),* 397-403.

Sloboda, J. A. & Lehmann, A. C. (2001). Tracking Performance Correlates of Changes in Perceived Intensity of Emotion During Different Interpretations of a Chopin Piano Prelude. *Music Perception, 19 (1),* 87-120.

Spackman, M. P., Brown, B. L., and Otto, S. D. (2009). Do emotions have distinct vocal profiles? A study of idiographic patterns of expression. *Cognition and Emotion, 23 (8)*, 1565-1588.

Tonkiss, F. (2004). Analysing text and speech: Content and discourse analysis. In C. Seale (Ed.), *Researching society and culture (2nd ed.)* (pp. 367–382). London: Sage.

Timmers, R. & Honing, H. (2002). On music performance, theories, measurement and diversity. In M. A. Belardinelli (Ed.), *Cognitive Processing (International Quarterly of Cognitive Sciences), 1-2*, 1-19.

Tolonen, T. & Karjalainen, M. (2000). A computationally efficient multipitch analysis model. *IEEE Transactions on Speech and Audio Processing, 8 (6),* 708-716.

Van Zijl, A. G. W. (2008). *The role of the performer's experienced emotion in the construction of a musically expressive performance.* Unpublished master's dissertation, Keele University, UK.

Van Zijl, A. G. W. & Luck, G. (2013a). Moved through music: The effect of experienced emotions on performers' movement characteristics. *Psychology of Music, 41(2),* 175-197.

Van Zijl, A. G. W. & Luck, G. (2013b). The sound of sadness: The effect of performers' emotions on audience ratings. In G. Luck & O. Brabant (Eds.) *Proceedings of the 3rd International Conference on Music & Emotion (ICME3)*, Jyväskylä, Finland.

Van Zijl, A. G. W. & Sloboda, J. (2011). Performers' experienced emotions in the construction of expressive musical performance: an exploratory investigation. *Psychology of Music, 39 (2),* 196-219.

Wallbott, H. G. (1998). Bodily expression of emotion. *European Journal of Social Psychology, 28*, 879-896.

Watson, D., Clark, L. A. & Tellegen, A. (1988). Development And Validation Of Brief Measures Of Positive And Negative Affect - The Panas Scales. *Journal of Personality and Social Psychology, 54 (6),* 1063-1070.

Woody, R. H. (2000). Learning Expressivity in Music Performance: An Exploratory Study. *Research Studies in Music Education, 14,* 14-23.

Zuckerman, M., Hall, J. A., DeFrank, R. S. & Rosenthal, R. (1976). Encoding and Decoding of Spontaneous and Posed Facial Expressions. *Journal of Personality and Social Psychology, 34 (5),* 966-977.

APPENDIX A

	Friedman's ANOVA	**Post-hoc Wilcoxon signed ranks tests**		
		Technical vs. Expressive	**Technical vs. Emotional**	**Expressive vs. Emotional**
Tempo – performance duration	$\chi^2(2) = 10.75$, $p < .01$	$Z = -0.70$, $p > .0167$	$Z = -1.68$, $p > .0167$	$Z = -2.52$, $p < .0167$
Tempo – fluctuation of bar duration	$\chi^2(2) = 1.75$, $p > .05$	N/A	N/A	N/A
Articulation – attack slope	$\chi^2(2) = 5.25$, $p > .05$	N/A	N/A	N/A
Dynamics – mean RMS	$\chi^2(2) = 6.25$, $p < .05$	$Z = -1.82$, $p > .0167$	$Z = -1.12$, $p > .0167$	$Z = -2.10$, $p > .0167$
Dynamic range	$\chi^2(2) = 6.75$, $p < .05$	$Z = -2.52$, $p < .0167$	$Z = 0.00$, $p > .0167$	$Z = -1.40$, $p > .0167$
Timbre – spectral centroid	$\chi^2(2) = 0.25$, $p > .05$	N/A	N/A	N/A
Timbre – roughness	$\chi^2(2) = 3.25$, $p > .05$	N/A	N/A	N/A
Vibrato depth	$\chi^2(2) = 14.25$, $p < .01$	$Z = -2.52$, $p < .0167$	$Z = -2.24$, $p < .0167$	$Z = -2.52$, $p < .0167$
Fluctuation of vibrato depth	$\chi^2(2) = 0.25$, $p > .05$	N/A	N/A	N/A
Vibrato rate	$\chi^2(2) = 11.67$, $p < .05$	$Z = -2.37$, $p > .0167$	$Z = -0.98$, $p > .0167$	$Z = -2.52$, $p < .0167$
Fluctuation of vibrato rate	$\chi^2(2) = 3.80$, $p > .05$	N/A	N/A	N/A

IV

THE SOUND OF SADNESS: THE EFFECT OF PERFORMERS' EMOTIONS ON AUDIENCE RATINGS

by

Anemone G. W. Van Zijl & Geoff Luck, 2013

Proceedings of the 3rd International Conference on Music and Emotion,
Finland: University of Jyväskylä

Proceedings of the 3rd International Conference on Music & Emotion (ICME3), Jyväskylä, Finland, 11th - 15th June 2013. Geoff Luck & Olivier Brabant (Eds.)

THE SOUND OF SADNESS: THE EFFECT OF PERFORMERS' EMOTIONS ON AUDIENCE RATINGS

Anemone G. W. Van Zijl, Geoff Luck

Department of Music, University of Jyväskylä, Finland
Anemone.vanzijl@jyu.fi

Abstract

Very few studies have investigated the effect of performers' felt emotions on the audience perception of their performances. Does it matter what a performer feels or thinks about when performing? To investigate this, we asked four violinists to play the same musical phrase in response to three different instructions. The first instruction was to focus on the technical aspects of their playing. The second instruction was to give an expressive performance. Following a sadness-inducing mood induction task, the third instruction was to play while focusing on their felt emotions. High quality audio and motion-capture recordings were made of all performances. Subsequently, motion-capture animations, audio recordings, and motion-capture animations combined with audio recordings of the performances were presented to an audience. Thirty audience members rated how much they liked each performance, how skilled they thought each performer was, and to what extent each performance was expressive of sadness. Statistical analysis revealed that, overall, audience members preferred the Expressive performances to the Technical and Emotional ones. In addition, the Expressive performances were rated as played by the most skilled performers. The Emotional performances, however, were rated as being most expressive of sadness. Our results suggest that what performers feel or think about when performing does affect the perception of their performances by an audience.

Keywords: performing musicians, felt emotions, audience perception

1. Introduction

Many studies have examined listeners' ability to recognize emotions expressed in music (e.g., Gabrielsson & Juslin, 2003; Juslin & Laukka, 2003; Eerola & Vuoskoski, 2013). In addition, the characteristics of the music – in terms of composed features (e.g., mode, harmonic, and rhythmic structure), performance features (e.g., tempo fluctuation, articulation, vibrato), and performer features (e.g., body movement, facial expression) – leading to the identification of certain emotions have been investigated (e.g., Clarke, 1988; Gabrielsson & Juslin, 1996; Gabrielsson & Lindström, 2010; Dahl & Friberg, 2007; Livingstone, Thompson & Russo, 2009). However, little is known about how performing musicians actually try to achieve a performance expressive of emotions, and whether performers' felt emotions play a role in this process (Gabrielsson, 2001-2002). Should musicians feel the musical emotions when expressing them? Or should they rather focus on technique or expressivity when trying to bring a musical message across?

To investigate this, we asked performers to play the same musical phrase in response to three different instructions. This resulted in high quality audio and motion-capture recordings of so-called Technical, Expressive, and Emotional performances. Computational analysis of the audio recordings revealed differences in playing tempo, dynamics, articulatory

features, timbral features, and the extent and rate of vibrato between the three performance conditions. The Expressive performances, for instance, were characterized by the fastest playing tempo, the loudest sound, the brightest and roughest timbre, direct note attacks, and a wide and fast vibrato, as compared to the Technical and Emotional performances (Van Zijl, Toiviainen, & Luck, 2012). Computational analysis of the motion-capture recordings revealed differences in body posture, amount, speed, acceleration, and smoothness of movement of the performers in the three performance conditions. In the Expressive performances, for instance, performers were standing most upright, and moved most, fastest, with the highest acceleration, and lowest smoothness, as compared to the Technical and Emotional performances (Van Zijl & Luck, 2013). Although computational analyses of the recordings revealed differences between performances played with a different focus of attention, the question remains whether these differences would influence audience perception of the performances.

To investigate the effect of performers' thoughts and feelings on audience perception, we asked audience members to rate each performance with regard to three statements. The first statement – 'I like this performance' – was related to preference. Do audience members have a preference for Technical, Expressive, or Emotional performances? The second statement – 'This performer is skilled' – was related to expertise. Do audience members perceive performers who focus on Technique, Expressivity, or felt Emotions as more skilled? The third statement – 'This performance is expressive of sadness' – was related to emotions. Do audience members perceive Technical, Expressive, or Emotional performances as most expressive of, in this case, sadness?

2. Method

2.1. Participants

Participants were thirty Master's Degree students (mean age = 28.07 years, SD = 5.64, females = 18) from a University in Finland. All participants had played a musical instrument (including voice) for at least one year, while the majority (63.3%) had played a musical instrument (including voice) for more than ten years.

2.2. Stimuli

The stimuli were performances of four violinists (two amateurs and two professionals, all females) who were asked to play the same musical phrase in response to three different performance instructions. The first instruction was to focus on the technical aspects of their playing (i.e., the Technical performances). The second instruction was to give an expressive performance (i.e., the Expressive performances). Following a sadness-inducing mood induction task, the third instruction was to play while focusing on their felt emotions (i.e., the Emotional performances). High quality audio and motion-capture recordings were made of all performances.

Subsequently, motion-capture animations were created using the MATLAB Motion Capture Toolbox (Toiviainen & Burger, 2010). Using the QuickTime 7 software, the motion-capture animations were paired with the audio recordings. A presentation film depicting the motion-capture animations, audio recordings, and motion-capture animations with audio recordings, was created using the iMovie software. The order of the performances was randomised within each presentation mode (see below).

2.3. Procedure

The performances were presented on a big screen in an auditorium. Participants were comfortably seated in the auditorium and the lights were dimmed, so as to resemble a real concert setting. Participants were asked to rate their agreement with the statements 1) I like this performance, 2) The performer is skilled, and 3) This performance is expressive of sadness, on a seven-point bipolar scale (completely disagree – completely agree). Participants were told that they would see or hear 36 performances played by different performers and with different performance intentions. They were neither told how many performers

had provided the performances, nor what the performance instructions had been.

The performances were presented in three blocks, each block containing the same performances but presented in different orders. In the first block, the motion-capture animations were shown without sound (i.e., Vision-only). In the second block, only the audio recordings were played (i.e., Audio-only). In the third block, the motion-capture animations were shown with sound (i.e., Vision & Audio). After each performance, participants had 20 seconds to rate the performance, until a sound signal indicated the start of the next performance.

To make sure all participants understood the rating procedure, data collection was preceded by an example of the same musical phrase performed by a bassoon player. After rating all performances, participants were asked to write down any comments they had about the study and their experiences. Data collection lasted about 45 minutes.

2.4. Analysis

Participants' ratings were entered into SPSS and analysed by means of three (one for each statement) three-way repeated-measures ANOVAs with presentation mode (Vision-only, Audio-only, Vision & Audio), expertise of the performer (Amateur, Professional), and performance condition (Technical, Expressive, Emotional) as independent variables. Correlations between ratings of the three statements were analysed by means of Pearson's Correlation Coefficient.

3. Results

We present the findings in accordance with the three statements investigating preference, perceived expertise, and perceived emotional expression. Figure 1 depicts the main effects of presentation mode (1A), expertise (1B), and performance condition (1C), as well as the two-way interactions between presentation mode and expertise (1D, 1G, 1J), presentation mode and performance condition (1E, 1H, 1K), and expertise and performance condition (1F, 1I, 1L).

3.1. Preference

The Vision-only performances received the highest preference ratings overall (Figure 1A), although the main effect of presentation mode on preference ratings was non-significant, $F(2, 58) = 1.92$, $p > .05$. There was a significant main effect of expertise on preference ratings, $F(1, 29) = 8.81$, $p < .01$, with the performances of the Professionals receiving the highest ratings overall (Figure 1B). The Expressive performances received the highest preference ratings overall (Figure 1C), and the main effect of performance condition on preference ratings was significant, $F(2, 58) = 13.43$, $p < .001$, with Bonferroni-corrected posthoc pairwise comparisons revealing a significant difference between the Technical and Expressive performances ($p < .001$), and between the Expressive and Emotional ones ($p < .001$), only.

As illustrated in Figures 1D and 1E, significant interactions were found between mode and expertise, $F(2, 58) = 19.51$, $p < .001$, and between mode and performance condition, $F(4, 116) = 2.84$, $p < .05$. The interaction between expertise and performance condition (Figure 1F) was non-significant, $F(2, 58) = 0.40$, $p > .05$. In addition, a significant three-way interaction was found between mode, expertise, and performance condition, $F(4, 116) = 4.06$, $p < .01$ (not shown).

3.2. Perceived expertise

The Vision & Audio performances received slightly lower ratings of perceived expertise (Figure 1A), although the main effect of presentation mode on expertise rating was non-significant, $F(1.36, 39.39) = 0.42$, $p > .05$. There was a significant main effect of the performers' expertise on perceived expertise ratings, $F(1, 29) = 39.13$, $p < .001$, with the performances of the Professionals receiving higher ratings than the Amateur performances (Figure 1B). The Expressive performances received the highest ratings of perceived expertise (Figure 1C). The main effect of performance condition on expertise ratings was significant, $F(2, 58) = 25.75$, $p < .001$, with Bonferroni-corrected posthoc pairwise comparisons revealing a

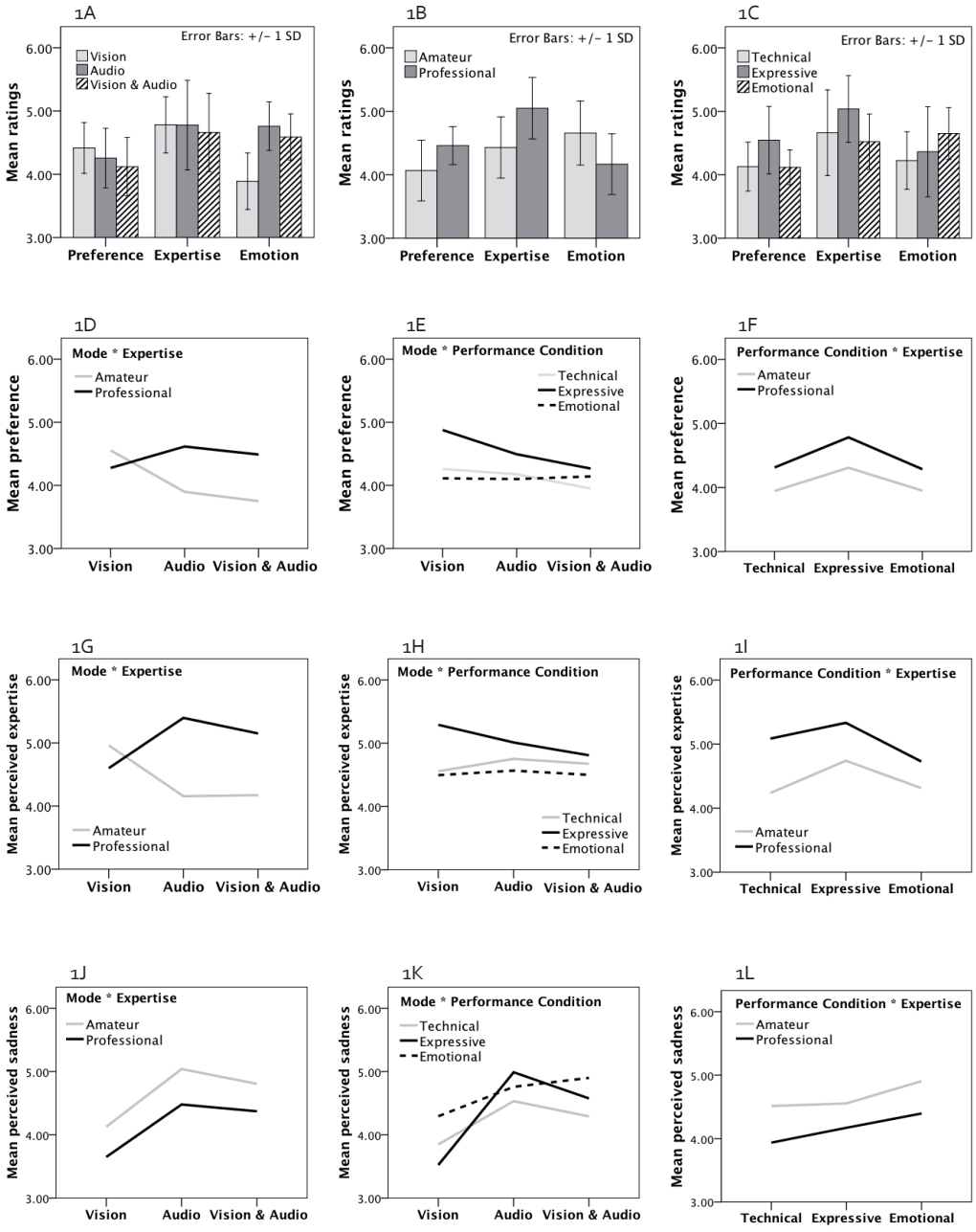

Figure 1. Main effects and two-way interactions of the repeated-measures ANOVAs.

significant difference between the Technical and Expressive performances ($p < .001$), and between the Expressive and Emotional ones ($p < .001$), only.

As depicted in Figures 1G, 1H and 1I, significant interactions were found between mode and expertise, $F(2, 58) = 60.54$, $p < .001$, between mode and performance condition, $F(4, 116) = 3.81$, $p < .01$, and between expertise and performance condition, $F(2, 58) = 3.27$, $p < .05$. In addition, a significant three-way interaction was found between mode, expertise, and performance condition, $F(3.17, 92.03) = 3.71$, $p < .05$ (not shown).

3.3. Perceived emotional expression

The performances in the Vision-only mode received lower ratings of perceived expression of sadness than the performances in the Audio-only and Vision & Audio modes (Figure 1A). The main effect of presentation mode on perceived emotional expression ratings was significant, $F(2, 58) = 15.38$, $p < .001$, with Bonferroni-corrected posthoc pairwise comparisons showing significant differences between the Vision-only and Audio-only presentation modes ($p < .001$), and between the Vision-only and Vision & Audio ones ($p < .01$), only. The performances of the Amateurs received higher ratings of perceived expression of sadness than the performances of the Professionals (Figure 1B). The main effect of expertise on perceived emotional expression ratings was significant, $F(1, 29) = 25.00$, $p < .001$. The Emotional performances received the highest ratings of perceived expression of sadness (Figure 1C). The main effect was significant, $F(2, 58) = 10.09$, $p < .001$, with Bonferroni-corrected posthoc pairwise comparisons showing a significant difference between the Technical and Emotional performances ($p < .001$), and between the Expressive and Emotional ones ($p < .05$), only.

As illustrated in Figure 1K, a significant interaction was found between mode and performance condition, $F(4, 116) = 7.41$, $p < .001$. As depicted in Figures 1J and 1L, the interactions between mode and expertise, $F(1.45, 41.93) = .24$, $p > .05$, between expertise and performance condition, $F(2, 58) = .67$, $p > .05$, and between mode, expertise, and performance condition, $F(4, 116) = 1.21$, $p > .05$ (not shown), were non-significant.

3.4. Correlations

A significant correlation was found between ratings of preference and perceived expertise, $r = .90$, $p < .001$. No correlation was found between ratings of preference and perceived emotional expression, $r = -.01$, $p > .05$, or between ratings of perceived expertise and perceived emotional expression, $r = -.14$, $p > .05$.

4. Discussion

Does it matter what a performer feels or thinks about when performing? The results of the present study suggest that a performer's focus of attention influences audience perception of a performance.

As illustrated in Figure 1C, statistical analysis of audience ratings revealed that, overall, audience members preferred the Expressive performances to the Technical and Emotional ones. In addition, the Expressive performances were rated as played by the most skilled performers. The Emotional performances, however, were rated as being most expressive of sadness.

When looking at differences between the Amateur and Professional performers, overall, the performances of the Professional violinists were rated higher in terms of preference and perceived skill. The Amateur performances, however, were perceived as being more expressive of sadness, as can be seen in Figure 1B.

The presentation mode, overall, did not really influence the ratings for preference and perceived expertise, as shown in Figure 1A. The presentation mode, however, did affect the ratings for perceived emotional expression. The ratings for perceived expression of sadness were much lower in the Vision-only condition.

The interactions between variables provided a more detailed view of the audience ratings. As depicted in Figures 1D and 1G, the presentation mode affected how the performances of the Amateurs and Professionals were perceived. In the Vision-only condition,

the performances of the Amateurs received higher ratings in terms of preference and perceived expertise. In the Audio-only and Vision & Audio conditions, the performances of the Professionals were rated higher. Analyses of the performers' movements revealed that the Amateurs moved more, more slowly, more smoothly, and with less acceleration than the professionals (Van Zijl & Luck, 2013). It seems that more extensive and more fluent movements were perceived as more pleasing, and were associated with a higher level of musical expertise – in the absence of sound. If we compare the ratings in the Vision & Audio condition to the Vision-only and Audio-only conditions, it becomes clear that the audience members were guided more by sound than by vision in their ratings.

As illustrated in Figure 1J, the performances in the Vision-only condition received the lowest ratings for perceived expression of sadness. This might be explained by the presentation order of the stimuli: When rating the performances in the Vision-only condition, the audience members did not know the piece that was played – although they heard it in the example performance. In addition, it might be difficult to infer the emotional expression of a performance by looking at motion-capture animations without the accompanying sound.

In all presentation modes shown in Figure 1J, the performances of the Amateurs were rated higher than the performances of the Professionals in terms of perceived expression of sadness. In addition to the differences in performers' movements, the differences in audio features of the Amateur and Professional performances might have been of influence here. Analysis of the audio features revealed that the Amateurs played slower, softer, with less direct note attacks, a different timbre, and a wider and slower vibrato, as compared to the Professionals (Van Zijl, Toiviainen, Luck, 2012). It seems that both the movement and auditory characteristics of the Amateur performances were more in line with the characteristics generally associated with the expression of sadness (e.g., Crane & Gross, 2007; Juslin & Laukka, 2003).

As illustrated in Figures 1E and 1H, the Expressive performances received higher ratings than the Technical and Emotional performances in terms of preference and perceived expertise of the performer in all modes of presentation. The presentation mode interacted in different ways with the Technical, Expressive, and Emotional performances. Again, this might be explained by the audio and movement characteristics of the performances. The Expressive performances were characterised by the fastest tempo, the loudest sound, the most bright and rough timbre, direct note attacks, and a wide and fast vibrato, as compared to the Technical and Emotional performances (Van Zijl, Luck, Toiviainen, 2012). In addition, in the Expressive performances, the performers moved most, fastest, with most acceleration, and lowest levels of smoothness, as compared to the Technical and Emotional ones (Van Zijl & Luck, 2013). The Expressive performances seemed to be of a more extraverted character, which was appreciated by the audience.

As depicted in Figure 1K, the ratings of perceived sadness were different for each presentation mode. In the Vision-only condition the Technical performances were perceived as being most expressive of sadness, followed by the Emotional and Expressive ones. In the Audio-only condition, The Expressive performances were rated highest, followed by the Technical and Emotional ones. And in the Vision & Audio condition, the Technical performances scored highest, followed by the Expressive and Emotional ones. Whereas the pattern in the Vision-only condition might be related to the movement characteristics of the performers (e.g., performers moved least in the Technical condition and most in the Expressive condition), the patterns in the other modes are difficult to explain.

As can be seen in Figure 1F and 1I, the performances of the Professionals received higher ratings in terms of preference and perceived expertise than the performances of the Amateurs. The Expressive performances of both the Amateur and Professional performers received higher ratings than the respective Technical and Emotional ones. As depicted in Figure 1L, in case of perceived expression of sadness the performances of the Amateurs received higher ratings than the Professional

performances. In case of perceived expression of sadness, the Emotional performances of both the Amateur and Professional performers received higher ratings than the respective Technical and Expressive ones. The finding that audience members preferred the Expressive performances and believed they were played by the most skilled performers but perceived the Emotional performances as being most expressive of sadness might suggest that a more external focus of the performer (i.e., 'give an expressive performance') results in a 'better' performance, whereas a more internal focus (i.e., 'focus on felt emotions') results in a performance more expressive of emotion.

Should musicians feel the musical emotions when expressing them? Or should they rather focus on technique or expressivity when trying to bring a musical message across? The findings of the present study suggest that a performer's focus of attention affects the perception of the performance by an audience. It was found that audience members perceived the Emotional performances as more expressive of sadness than the Technical and Expressive ones. It seems that sad feelings of the performer can make a sad piece of music sound sadder. Although we cannot simply equate the lab setting of the present research with a real concert situation, the findings are valuable for music research, education and performance: It does matter what a performer feels or thinks about while performing.

Acknowledgements

We would like to thank the musicians who provided the stimuli and the students who provided the ratings. The research reported here was supported by the Academy of Finland (project number 7118616).

References

Clarke, E. F. (1988). Generative principles in music performance. In Sloboda, J. A. (Ed.) *Generative processes in music*. Oxford: Oxford University Press.

Crane, E., & Gross, M. (2007). Motion capture and emotion: Affect detection in whole body movement. In A. Paiva, R. Prada, & R. W. Picard (Eds.), *Affective computing and intelligent interaction: Lecture notes in computer science* (pp. 95–101). Berlin: Springer-Verlag.

Dahl, S. & Friberg, A. (2007). Visual perception of expressiveness in musicians' body movements. *Music Perception*, 24(5), 433-454.

Eerola, T. & Vuoskoski, J. K. (2013). A review of music and emotion studies: Approaches, emotion models and stimuli. *Music Perception*, 30(3), 307-340.

Gabrielsson, A. (2001–02). Emotion perceived and emotion felt: Same or different? *Musicae Scientiae* [Special issue], 123–147.

Gabrielsson, A. & Juslin, P.N. (1996). Emotional Expression in Music Performance: Between the Performer's Intention and the Listener's Experience. Psychology of Music, 24, 68-91.

Gabrielsson, A. & Juslin, P.N. (2003). Emotional expression in music. In Davidson, R. J., Scherer, K. R. and Goldsmith, H. H. Handbook of Affective Sciences. Oxford: Oxford University Press.

Gabrielsson, A. & Lindström, E. (2010). The role of structure in the musical expression of emotions. In Juslin, P. N. & Sloboda, J. A. (Eds.) *Handbook of Music and Emotion. Theory, Research, Applications.* (pp. 367-400). Oxford: Oxford University Press.

Juslin, P. N. & Laukka, P. (2003). Communication of Emotions in Vocal Expression and Music Performance: Different Channels, Same Code? *Psychological Bulletin*, 129 (5), 770-814.

Livingstone, S. R., Thompson, W. F., & Russo, F. A. (2009). Facial Expressions and Emotional Singing: A Study of Perception and Production with Motion Capture and Electromyography. *Music Perception*, 26(5), 475-488.

Toiviainen, P., & Burger, B. (2010). MoCap Toolbox manual. Retrieved from: http://www.jyu.fi/music/coe/materials/mocaptoolbox/MCTmanual

Van Zijl, A. G. W. & Luck, G. (2012). Moved through music: The effect of experienced emotions on performers' movement characteristics. Psychology of Music, 41(2), 175-197.

Van Zijl, A. G. W., Toiviainen, P., & Luck, G. (2012). The sound of emotion: The effect of performers' emotions on auditory performance characteristics. In Cambouropoulus, E., Tsougras, C., Mavromatis, P., Pastiades, K. (Eds.) Proceedings of the 11th ICMPC and 8th ESCOM Conference. (pp. 1064-1068). Greece: University of Thessaloniki.

V

EMOTIONS IN CONCERT: PERFORMERS' EXPERIENCED EMOTIONS ON STAGE

by

Anemone G. W. Van Zijl & John A. Sloboda, 2013

Proceedings of the 3rd International Conference on Music and Emotion,
Finland: University of Jyväskylä

Proceedings of the 3rd International Conference on Music & Emotion (ICME3), Jyväskylä, Finland, 11th - 15th June 2013. Geoff Luck & Olivier Brabant (Eds.)

EMOTIONS IN CONCERT: PERFORMERS' EXPERIENCED EMOTIONS ON STAGE

Anemone G. W. Van Zijl[*], John A. Sloboda[†]

[*]Department of Music, University of Jyväskylä, Finland
[†]Guildhall School of Music and Drama, United Kingdom
Anemone.vanzijl@jyu.fi

Abstract

Music is often said to be expressive of emotions. Surprisingly, not much is known about the role of performers' emotions while performing. Do musicians feel the musical emotions when expressing them? Or has expressive playing nothing to do with the emotional experiences of the performer? To investigate performers' perspectives on the role of emotions in performance, we conducted qualitative in-depth interviews with nineteen musicians teaching or studying at a European conservatoire. In the interviews, musicians were first asked to describe a recent performance experience in as much detail as possible, then to make a visual representation of their experiences on stage, and finally, to answer some general questions about the role of emotions in performance. Qualitative Thematic Analysis of the interview transcripts revealed a difference between performance related emotions and emotions related to the music. In addition, a difference was found between emotional and expressive playing. To allow the music to be expressive of emotions, performers seem to feel the musical emotions to some extent, while they make sure to have the technical ability to express them on their instrument, and stay in control of their playing.

Keywords: performing musicians, felt emotions, expressive performance

1. Introduction

Do musicians feel the musical emotions when expressing them? Or has expressive playing nothing to do with the emotional experiences of the performer? Little is known about the relationship between felt and expressed emotions in performing musicians (Gabrielsson, 2001-2002). Some musicians and researchers adhere to the vision that 'A musician cannot move others unless he too is moved' (C.Ph.E. Bach, quoted in Persson, 2001). Others argue that performing is more a matter of deliberate conscious awareness and planned expressiveness: 'I also have to play pieces which are not so emotionally connected to me, because I am a professional' (pianist interviewed by Sloboda & Lehmann, 2001).

Expressivity is a multi-dimensional and largely investigated subject (e.g., Juslin, 2001; 2003), as is the study of whether music is expressive of emotions (e.g., Juslin & Laukka, 2003; Vuoskoski, 2012). Surprisingly, there is little systematic knowledge about whether performers' experienced emotions play a role in the creation of an expressive performance (Juslin, 2009).

In several studies (e.g., Woody, 2000; Karlsson & Juslin, 2008), playing expressively and playing with emotions are considered as being one and the same. Studies by Lindström et al. (2003) and Van Zijl and Sloboda (2011), however, suggest that there might be a difference between emotional and expressive playing.

Lindström et al. (2003) conducted a questionnaire study to investigate how conservatoire students approach the subject of expressivity. They found that 44 percent of the students defined 'playing expressively' largely in terms of 'communicating emotions', while 16 percent defined 'playing expressively' in terms of 'playing with feeling'. According to Lindström et al., the first way of defining focuses more on actually conveying something to the audience, whereas the second one focuses more on the performer's own feelings.

In a diary and interview study investigating performers' emotions during the process of constructing an expressive performance in private practice or rehearsal, Van Zijl and Sloboda (2011) found that music students described 'emotional playing' as 'just feeling and enjoying the music'. In the case of an expressive performance, the communication of a previously constructed musical interpretation to an audience seemed to take centre stage, rather than the performers' own feelings.

In the present study we aimed to investigate what role performers' experienced emotions play on stage, by asking performers to reflect on a recent performance experience. In addition, we aimed to explicate the meaning of emotional and expressive playing in music performance.

2. Method

2.1. Participants

Participants in the present study were nineteen musicians (11 females), teaching (N = 6) or studying (N = 13) at the Guildhall School of Music and Drama, a conservatoire in London, United Kingdom. Participants played the violin, viola, cello, double bass, flute, clarinet, French horn, percussion, harp, or piano. Classical music was the stylistic aim in education for all participants. Participants were recruited via an invitation email.

2.2 Procedure

The in-depth, semi-structured interviews consisted of four parts. In the first part, the structure of the interview was explained, participants were asked to sign a consent form, and given the opportunity to ask any questions. In the second part, participants were asked to think of a recent performance experience. They were encouraged to describe this experience in as much detail as possible, and describe what they experienced before the performance, when going onstage, when starting to play, while playing, when ending the performance, and after the performance. In the third part, participants were asked to make a visual representation (with pencil on paper) of their experiences on stage. In the fourth part, participants were asked to answer some general, reflective questions: how they would describe their ideal performance, how they would describe emotional and expressive playing, whether emotions help them and whether they hinder them, to what extent they think emotions are necessary for a successful performance, if they could think of any aspect related to emotions not discussed yet, and whether they had anything to add or ask. The interviews typically lasted about 60 minutes (range: 50 – 90 minutes).

2.3. Analysis

The interviews were transcribed and subsequently analysed by means of Qualitative Thematic Analysis. This involves an interpretative analysis of textual meaning based on a coding scheme derived both deductively from pre-existing concerns, questions and hypotheses, and inductively from examination of the actual data (Seale, 2004).

3. Results

Analysis of the interviews allowed a detailed characterisation of the role of performers' emotions on stage. A distinction was revealed between performance-related emotions and emotions related to the music. In addition, it was found that emotional and expressive playing were perceived in different ways.

3.1. Performance-related emotions

Performance related emotions as described by the musicians were emotions such as excite-

ment or anxiety, and they were typically featured by an urge to move or play faster, and bodily sensations such as sweaty hands, muscle tension, or trembling. In the words of two of the participants:

> I noticed that I was shaking slightly, like round my embouchure area. Erm…and I had, like, sweaty palms. But that's like a standard thing, really, when…well, when anyone performs, I guess. (Clarinettist, student)

> …I was worried that I would mess up my playing and then it would be really embarrassing. But I think it just takes practise. Performance needs to be practised. (Harpist, student)

3.2. Music-related emotions

In addition to emotions related to the act of performing in front of an audience, performers tend to experience emotions in relation to the music they perform. The present study revealed that music-related emotions reflect a complex relationship between the music and the performer. This is illustrated by the following quote:

> …Schubert G Major Quartet is such a work of immense scope and magnitude, and it really deals with the essence of light and dark and optimism and despair. Erm…and I guess in the music he has reflected that, very simply, in major and minor, and so there's a huge, sort of, dialogue between major and minor, even from the very first…or even from the opening of the piece. Erm…and I think also…I mean, obviously, he knew that he was dying when he wrote it, and…erm… Every person's interpretation of what he's written, I guess, would be different, but for me, I just do find a huge…erm…sense of loss and…and anger: I think there is anger in this music, or maybe anger at the loss that he's going through, in saying goodbye to his life. Erm…and also, huge tenderness as well, so…that's…that's, I guess, what I mean by extreme music. Because it encompasses such a huge scale of…of human emotion. Erm…and so, in this particular performance…erm…I just…I felt very connected to…to that. And… I…I felt able…to really…I felt very sad. I felt…I felt really sorry for him. And I felt…I could also identify, as I was playing, I could identify with the anger in the music, and the despair, and the loss, and…erm…and I guess…I feel that I was able to, at least for myself, connect with that physically, and sort of manifest it on my instrument. And it…and it gave me like a spur of energy. To actually…to creating the line of music the way that I feel it. (Viola player, staff)

The score played a central role in the accounts of the musicians interviewed. This may reflect the fact that in classical music, the score, the composer's intentions, and conventions regarding styles of playing occupy centre stage. A score, however, needs to be interpreted. The process of interpreting the score mainly takes place in the practise room, where musicians translate the notes into a musical narrative and try to find and master the technical means to manifest the narrative on their instruments (see also Van Zijl & Sloboda, 2011).

In order to bring the musical narrative to life, on stage, the musicians in the present study tend to connect emotionally with the musical narrative by relying on life experiences, and connecting to the reason why they are musicians: their love for music, the desire to share their music with others, and the belief that music has some deeper meaning which needs to be understood and communicated.

When connecting emotionally with the musical narrative, all participants emphasised the importance of maintaining a balance between being emotionally involved (in a way a listener might be) and being in control of their playing. In addition, all musicians emphasised the need to have the technical ability to express the musical narrative on their instrument. The balance between being emotionally involved and being in control of their playing is reflected in the performers' perspectives on emotional and expressive playing.

3.3. Emotional playing

In the interviews, all musicians described the difference between emotional and expressive playing in a similar way. Emotional playing was associated with genuine playing, with experiencing raw emotions, and with directly feeling the emotional impact of the music. In the words of several participants:

> 'Emotional'... it's more of an adrenaline driven thing. I mean, in the moment, if you can...if you just feel the sudden sensation or emotion, it can really carry you. (Violinist, student)

> 'Emotional' is being involved in... in a very personal way...and feeling very directly the emotional impact on me while I'm playing... I'm going through the feeling, while I'm playing. (Flautist, staff)

> ...it's feeling the emotion you're dealing with when you play. And feeling a sense of catharsis or...or...it's almost a variant on...on having an orgasm while making love. Really. It can get to...to that. It's, of course, not the same, and...but some...some of the sensation is similar. (Pianist, staff)

In addition to emotional playing as a positive and personal experience of the music, emotional playing was associated with the risk of getting carried away, and losing control of performance. In the words of two participants:

> ...sometimes it's very easy to get so carried away that you're not in the room anymore. And then suddenly you come back to the room and it really sort of makes you jump, and...I think...erm...yeah: if you get too carried away, you go too far into your thoughts, and then when you come back into reality, it's quite a...a shock. And that's what makes you make mistakes, I think. (Pianist, student)

> When I get emotional, I'm carried away, and I...I lose the sense of... my feeling is it's a risk of losing the sense of control, which is so important for...erm...you know: successful performance. (Flautist, staff)

Several musicians gave examples of concert situations in which they got carried away too much. In the words of one of them:

> ...today, I played the Shostakovich Prelude and Fugue No. 15, and the fugue is just insane. Like, the hardest thing I've ever attempted to play in my entire life. And...erm...because it was so difficult, and I was so excited by the...just the whole...the whole fugue is just basically...the emotion behind it, I'd probably describe it as something like... erm... bizarre madness... erm... and excitement with anxiety at the same time. It was weird. But it's like really, really, really excited, and...you know: no rest in it at all, you know. So, as a performer, I have to try and generate that, you know, while I play it. And I just got so carried away in the middle that the technical aspect of it - which is very important...erm... probably because I was focusing on the meaning behind it more than the technique - then...erm...the technique got lost, and in losing the technique, you lose some of the communicative power, you know? Which is...er...a shame. (Pianist, student)

All musicians agreed that experiencing emotions while playing is important for their motivation to practise and perform. However, most musicians indicated that it is not that helpful to experience strong emotions on stage. In the words of two participants:

> ...the strong emotional experience possibly is not helpful at the time of performance. (...) I think my job is to play as beautifully as possible, and...and... in a way that doesn't distract anybody that's listening. So if I knock over a few notes, that's going to be distracting, and is going to stop the music having its effect on somebody else. So it's my responsibility to actually...you know: someone else receives; I give. (French horn player, staff)

> Well, I think you have to control your emotions, basically, because you're not only...you have to...there's a physical element to playing an instrument, and as much as we'd like it all to be completely free or whatever, you have to assert some control, and control, kind of in some sense, goes against emotion. Like, raw emotion. (Cellist, student)

3.4. Expressive playing

Expressive playing, on the other hand, was associated with playing what the score prescribes, with bringing out the structure of the music, and having the technical ability to express the composer's intentions. In the words of three participants:

> 'Expressive' playing can be something which is...erm... done more in a distance from the emotion itself, from the pure emotion. It's more a musical phenomenon. It's about... maybe

> more thinking about the differences in, you know: timing and timbre and whatever. Er... changing the music, you know, moment to moment, and fluctuations of all the musical parameters. 'Expressive' means being in and out at the same time. I'm observing while I'm doing, while experiencing. (Flautist, staff)

> 'Expressive' playing may suggest more that it comes from the music. So somebody who really thought about the music and really chooses which notes to...to lean on, for example. Erm... and it... has a real awareness of the structure of the whole piece, so you feel like they know where they're going in the piece, and they take you on that journey. Expressive playing makes me think of somebody who's actually really studied the score and worked out what they want to do with each part of the music.
> (Pianist, staff)

> ...expressive playing, I would say, contains the emotional aspect, and contains everything you feel about it, but you're also able to express it to somebody else... as opposed to keeping it in your head and just hoping it comes out. Erm...but having...having...yeah: having something to say and the tools to say it.
> (Violinist, student)

Although several musicians believed that one could give a successful performance without being emotionally involved, it was suggested that being emotionally connected with the musical narrative might turn a technically perfect performance into a remarkable one. In the words of two participants:

> I think emotions might not be very essential if you have flawless technique. If you play everything correct... if you play the music beautifully, it is a successful performance. But maybe it's not the best performance. I think emotion, it's... it makes it the top. (Harpist, student)

> I think if the emotions are channelled in the right way then they can really make a special performance, but I think that you could have a really brilliant performance without necessarily somebody having to be emotionally involved. (Pianist, staff)

On stage, the interviewed musicians all aimed for expressive playing rather than emotional playing. They seemed to identify with and feel the musical emotions to some extent, while making sure to have the technical ability to express the musical emotions on their instrument, and while being in control of what they are doing.

4. Discussion

In the present study we aimed to investigate what role performers' experienced emotions play on stage, by asking performers to reflect on a recent performance experience. We found a difference between performance-related emotions and emotions related to the music. As regards the music-related emotions, a complex relationship was found between the music and the performer.

In addition, we aimed to explicate the meaning of emotional and expressive playing in music performance. In line with the findings by Lindström et al. (2003) and Van Zijl and Sloboda (2011), we found a difference between emotional and expressive playing. Emotional playing was associated with genuine playing, with experiencing raw emotions, and with directly feeling the emotional impact of the music. It was also associated with the risk of getting carried away, and losing control of performance. Expressive playing, on the other hand, was associated with playing what the score prescribes, with bringing out the structure of the music, and having the technical ability to express the composer's intentions.

The finding by Lindström et al. (2003) that music students defined 'playing expressively' either in terms of 'communicating emotions' (focus on conveying something to the audience) or in terms of 'playing with feeling' (focus on the performer's own feelings), might suggest that the role of performers' experienced emotions in expressive performance is something musicians discover at some point during their education, and that musicians have to make the transition from approaching musical emotions as a listener to approaching musical emotions as a performer.

Although it is possible to experience strong emotions while playing, performers cannot neglect the fact that there is a physical aspect to playing an instrument, and that they are

likely to make mistakes and lose control of their playing when getting carried away too much. In addition, just feeling something does not necessarily mean that that feeling is transmitted to an audience. Several of the musicians interviewed indicated how different a recording could sound to how they thought it would sound based on their experiences while playing. All musicians interviewed emphasised the need to translate the notes into expressive music by finding and mastering the appropriate technical means before entering the stage.

Do musicians feel the musical emotions when expressing them? Or has expressive playing nothing to do with the emotional experiences of the performer? The results of the present study suggest that performers feel the musical emotions to some extent, while they make sure to have the technical ability to express them on their instrument, and stay in control of their playing. The findings support the validity of distinguishing between emotional and expressive playing, and seem to be valuable for both research and artistic practice and pedagogy.

Acknowledgements

We would like to thank the musicians teaching or studying at the Guildhall School of Music and Drama who participated in the study. The first author received an International Mobility Grant from the University of Jyväskylä and was supported by the Academy of Finland (project number 7118616) during the course of the research.

References

Gabrielsson, A. (2001–02). Emotion perceived and emotion felt: Same or different? *Musicae Scientiae* [Special issue], 123–147.

Juslin, P. N. (2001). Communicating emotion in music performance: A review and theoretical framework. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 431–449). Oxford: Oxford University Press.

Juslin, P. N. (2003). Five facets of musical expression: A psychologist's perspective on music performance. *Psychology of Music*, *31*(3), 273–302.

Juslin, P. N. (2009). Emotion in music performance. In: Hallam, S., Cross, I. and Thaut M. (Eds.) *The Oxford Handbook of Music Psychology.* (pp. 377-389). Oxford: Oxford University Press.

Juslin, P. N. & Laukka, P. (2003). Communication of Emotions in Vocal Expression and Music Performance: Different Channels, Same Code? *Psychological Bulletin, 129* (5), 770-814.

Karlsson, J. & Juslin, P. N. (2008). Musical Expression: an observational study of instrumental teaching. *Psychology of Music, 36* (3), 309-334.

Lindström, E., Juslin, P. N., Bresin, R., & Williamon, A. (2003). 'Expressivity comes from within your soul': A questionnaire study of music students' perspectives on expressivity. *Research Studies in Music Education, 20*, 23–47.

Persson, R. S. (2001). The subjective world of the performer. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion. theory and research* (pp. 275–289). Oxford: Oxford University Press.

Seale, C. (2004). Coding and analysing data. In C. Seale (Ed.), *Researching society and culture (2nd ed.)* (pp. 305–323). London: Sage.

Sloboda, J. A., & Lehmann, A. C. (2001). Tracking performance correlates of changes in perceived intensity of emotion during different interpretations of a Chopin piano prelude. *Music Perception, 19*(1), 87–120.

Van Zijl, A. G. W., & Sloboda, J. A. (2011). Performers' experienced emotions in the construction of expressive musical performance: An exploratory investigation. *Psychology of Music*, 39(2), 196-219.

Vuoskoski, J. K. (2012). Emotions represented and induced by music. The role of individual differences. [Doctoral Thesis] University of Jyväskylä, Finland.

Woody, R. H. (2000). Learning Expressivity in Music Performance: An Exploratory Study. *Research Studies in Music Education, 14*, 14-23.