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*Convened by*





## Welcome to ISPS 2013

The University of Music and Performing Arts Vienna (mdw) is delighted to host the fourth International Symposium on Performance Science at our beautiful downtown campus.

With over 3000 students, the mdw is among the largest art universities worldwide and offers the highest quality education for musicians, actors, film makers, and educators alike. With six specialised scholarly and scientific research institutes, among them the renowned Institute of Music Acoustics (IWK), the mdw encourages interdisciplinary collaboration between the arts and sciences.

We are convinced that developing artistic, creative, and professional performance in music, dance, and theatre also requires up-to-date scientific approaches that enable informed discussion, critical reflection, and competent exchange between researchers and performers for their mutual benefit. Thus, we consider performance science to be an integral part of our university.

On behalf of the mdw, our partners at the Royal College of Music, and the ISPS 2013 scientific committee I welcome you to Vienna and wish you an exciting and creative exchange of ideas.

Werner Hasitschka, Rector  
University of Music and Performing Arts Vienna

## Scientific committee

Aaron Williamon, *co-chair*  
Royal College of Music, London (UK)

Werner Goebel, *co-chair*  
University of Music and Performing Arts Vienna (Austria)

Richard Ashley  
Northwestern University (USA)

Matthias Bertsch  
University of Music and Performing Arts Vienna (Austria)

Sofia Dahl  
Aalborg University (Denmark)

Bruno Gingras  
University of Vienna (Austria)

Evangelos Himonides  
Institute of Education, University of London (UK)

Reinhard Kopiez  
Hanover University of Music, Drama and Media (Germany)

Masanobu Miura  
Ryukoku University (Japan)

Peter Pfordresher  
University at Buffalo State University of New York (USA)

Olivier Senn  
Lucerne University of Applied Sciences and Arts (Switzerland)

Kate Stevens  
University of Western Sydney (Australia)

Barbara Tillmann  
University of Lyon (France)

Oliver Vitouch  
University of Klagenfurt (Austria)

Matthew Wyon  
University of Wolverhampton (UK)

## General information for delegates

### Reception and information desk

The ISPS information desk will be situated in the Entrance Hall (ground floor) of the University of Music and Performing Arts Vienna (mdw), located at Anton-von-Webern-Platz 1, 1030 Vienna. Registration will open at 08:30 on Wednesday, 28 August, and the information desk will be open each day of the conference from 08:30 to 18:30.

### Delegate pack

Your delegate pack should contain the following:

- delegate badge
- conference program
- conference proceedings
- tickets for lunches and the conference dinner (if applicable)
- list of delegates
- pen and notepad
- city map and information on Vienna

Additional copies of the conference program will be available at the ISPS information desk or downloadable via the conference website, [www.performancescience.org](http://www.performancescience.org).

### Delegate badge

Access to conference sites, performances, social events, and meal venues will be by delegate badge only. For security purposes, it is recommended that you wear your badge at all times while on campus at the mdw.

### Messages and notice board

A message and notice board will be situated near the ISPS information desk throughout the conference. Please check it regularly as any announcements, messages for delegates, and changes to the program will be posted there. Anyone outside the conference wishing to leave messages for delegates should telephone +43 1 71155 4311 and ask for ISPS 2013 co-chair Werner Goebel. Alternatively, emails can be sent to [goebl@mdw.ac.at](mailto:goebl@mdw.ac.at).

### Meals and refreshments

Refreshments (tea/coffee) and lunch will be available during breaks in the scheduled program (see pp.7-9 for times). The conference dinner will be on Friday, 30 August, from 19:30 at the Vienna City Hall (*address*: Lichtenfelsgasse 2, 1082 Vienna). A leaflet containing directions for travel to the City Hall is available in your delegate pack and from the ISPS information desk

### Internet facilities

Wireless internet access will be available for delegates for the duration of the conference. The mdw is part of the eduroam system, a world-wide roaming access service for local wireless internet access, with which you may use your own eduroam account to log in. Alternatively, connect to mdw-guest, open a browser window, and enter username "isps2013" and password "welcome2mdw".

### Assistants and technical support

Conference assistants will be available throughout the event to answer questions and provide general assistance. Each presentation room will have a designated assistant to give technical and logistic help as required.

## **Emergencies**

The mdw main reception is situated in the ground floor Entrance Hall, where a first aid kit is located. In the event of an emergency, please notify a member of mdw staff or an ISPS conference assistant. In case of *fire* or if you require an *ambulance* or the *police*, dial **112** to notify the Emergency Services, then notify the nearest member of staff (or dial 150 from an internal university phone). For any other urgent issues, dial +43 1 71155 4311 and ask for ISPS 2013 co-chair Werner Goebel.

## **Notes for presenters**

### *Instructions for presenters of spoken papers*

The time allocated for spoken papers is 20 minutes, with a further 5 minutes for questions and 5 minutes for changeovers. Due to the busy conference schedule, it is important that sessions keep to time; therefore, session Chairs have been instructed to cut short any papers that overrun their allotted time. Speakers should ensure that their equipment needs are met before the start of the session. Conference rooms will be open 30 minutes before each session, and an assistant will be available to offer help as required.

### *Instructions for presenters of posters*

Posters will be displayed on Friday, 30 August. Each poster has been allocated a number and should be placed on the board corresponding to that number. Posters should be mounted during the registration period (08:30-09:00) on 30 August. Assistants will be on hand to provide special adhesive for attaching posters to the boards. The period from 10:30-11:30 has been specifically set aside for delegates to view posters. No other sessions will take place at this time, and presenters are required to be by their posters to answer questions. Posters will also be available for viewing during refreshment and lunch breaks on 30 August and should be removed by 16:30.

## Quick reference timetable

### Wednesday, 28 August 2013

08:30-10:00	Registration	Entrance Hall
10:00-10:15	Welcome to ISPS 2013	Joseph Haydn Saal
10:15-11:15	<i>Keynote address</i> Emma Redding (Trinity Laban Conservatoire of Music and Dance) Dancers: Fit bodies?	Joseph Haydn Saal
11:15-11:45	Break (with refreshments)	Entrance Hall <i>and</i> Haydn Saal Foyer
11:45-13:15	<i>Thematic sessions</i> Control of sequential movements in musical performance Performance education I Perspectives on performance	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal
13:15-14:45	Lunch	Courtyard <i>and</i> Cafeteria
14:45-16:15	<i>Thematic sessions</i> Capturing musical movement Performance education II The science of dance I	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal
16:15-16:45	Break (with refreshments)	Entrance Hall <i>and</i> Haydn Saal Foyer
16:45-18:15	<i>Thematic sessions</i> Approaches to motor learning Performance education III The science of dance II	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal
18:15-18:30	Break	
18:30-	Concert (followed by reception)	Joseph Haydn Saal

### Thursday, 29 August 2013

08:30-09:00	Registration	Entrance Hall
09:00-10:30	<i>Thematic sessions</i> Insights into sound practice Performance practice Performing together I	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal
10:30-11:00	Break (with refreshments)	Entrance Hall <i>and</i> Haydn Saal Foyer
11:00-12:30	<i>Thematic sessions</i> Insights into sound practice ( <i>cont.</i> ) Career perspectives Performing together II	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal
12:30-14:00	Lunch	Courtyard <i>and</i> Cafeteria
14:00-15:00	<i>Keynote address</i> Peter E. Keller (University of Western Sydney) Musical ensemble performance: A theoretical framework and empirical findings on interpersonal coordination	Joseph Haydn Saal
15:00-15:15	Break (with refreshments)	Entrance Hall <i>and</i> Haydn Saal Foyer
15:15-16:45	<i>Thematic sessions</i> Brass and woodwind research Performance anxiety Performing together III	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal

**Thursday, 29 August 2013 (cont.)**

16:45-17:00	Break	
17:00-17:45	<i>Graduate award paper</i> Friedrich Platz (Hanover University of Music, Drama, and Media) The influence of performers' stage entrance behavior on the audience's performance elaboration	Joseph Haydn Saal
17:45-19:00	<i>Workshops</i> The actor becomes The craft of collaboration	Clara Schumann Saal Fanny Mendelssohn Saal

**Friday, 30 August 2013**

08:30-09:00	Registration	Entrance Hall
09:00-10:00	<i>Keynote address</i> Alan M. Wing (University of Birmingham) Follow my leader? String quartet synchronization	Joseph Haydn Saal
10:00-10:30	Break (with refreshments)	Entrance Hall <i>and</i> Haydn Saal Foyer
10:30-11:30	Poster session	Entrance Hall
11:30-13:00	<i>Thematic sessions</i> Ensemble synchronization Analyzing musical movement Perception of pitch	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal
13:00-14:30	Lunch	Courtyard <i>and</i> Cafeteria
14:30-16:00	<i>Thematic sessions</i> Performance health and wellbeing I Techniques for memorizing performance Timing and dynamics in Mande ensemble drumming	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal
16:00-16:30	Break (with refreshments)	Entrance Hall <i>and</i> Haydn Saal Foyer
16:30-18:00	<i>Thematic sessions</i> Performance health and wellbeing II Evaluating music performance The science of dance III	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal
18:00-19:30	Break	
19:30-	Conference dinner	Vienna City Hall

**Saturday, 31 August 2013**

08:30-09:00	Registration	Entrance Hall
09:00-10:30	<i>Thematic sessions</i> The collaborative space Piano performance I Modeling and analyzing improvisation	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal
10:30-11:00	Break (with refreshments)	Entrance Hall <i>and</i> Haydn Saal Foyer
11:00-12:30	<i>Thematic sessions</i> Creating collaborative performance Piano performance II Analyzing the performance of contemporary music	Joseph Haydn Saal Clara Schumann Saal Fanny Mendelssohn Saal



**Saturday, 31 August 2013 (cont.)**

12:30-14:00	Lunch	Courtyard <i>and</i> Cafeteria
14:00-15:30	<i>Thematic sessions</i> The science of singing Theoretical perspectives	Joseph Haydn Saal Clara Schumann Saal
15:30-16:00	Break (with refreshments)	Entrance Hall <i>and</i> Haydn Saal Foyer
16:00-17:00	<i>Keynote address</i> W. Tecumseh Fitch (University of Vienna) Rhythm, meter, drumming, and dance: A predictive systems view of an ancient aspect of music	Joseph Haydn Saal
17:00-17:30	Closing remarks and announcement of ISPS 2015	Joseph Haydn Saal



## Wednesday, 28 August 2013

08:30-10:00	<p style="text-align: center;">REGISTRATION</p> <p style="text-align: center;">Entrance Hall</p>		
10:00-10:15	<p style="text-align: center;">WELCOME TO ISPS 2013</p> <p style="text-align: center;">Joseph Haydn Saal</p>		
10:15-11:15	<p style="text-align: center;">KEYNOTE ADDRESS</p> <p style="text-align: center;">Emma Redding Trinity Laban Conservatoire of Music and Dance</p> <p style="text-align: center;">Dancers: Fit bodies? (p.24)</p> <p style="text-align: center;"><i>Chair:</i> Colin Lawson</p> <p style="text-align: center;">Joseph Haydn Saal</p>		
11:15-11:45	<p style="text-align: center;">BREAK</p> <p style="text-align: center;">(with refreshments)</p> <p style="text-align: center;">Entrance Hall <i>and</i> Haydn Saal Foyer</p>		
11:45-13:15	<p style="text-align: center;"><u>SYMPOSIUM</u></p> <p style="text-align: center;">Control of sequential movements in musical performance</p> <p style="text-align: center;"><i>Chair:</i> Terry Clark</p> <p style="text-align: center;">Joseph Haydn Saal</p> <p style="text-align: center;"><u>Herrojo Ruiz, Kühn</u> Neuronal mechanisms underlying early acquisition and action-monitoring of piano sequences (p.24)</p> <p style="text-align: center;"><u>Furuya, Altenmüller</u> Hand motor control in skilled and impaired piano playing (p.24)</p> <p style="text-align: center;"><u>Verrel, Woollacott</u> Using motion capture analysis to characterize skilled cello bowing (p.25)</p>	<p style="text-align: center;"><u>THEMATIC SESSION</u></p> <p style="text-align: center;">Performance education I</p> <p style="text-align: center;"><i>Chair:</i> Reinhard Kopiez</p> <p style="text-align: center;">Clara Schumann Saal</p> <p style="text-align: center;"><u>Chaffin, Gerling <i>et al.</i></u> Theory and practice: A case study of how Schenkerian analysis shaped the learning of Chopin's <i>Barcarolle</i> (p.25)</p> <p style="text-align: center;"><u>Kruse-Weber, Parncutt</u> Error tolerance and error prevention in music performance: Risk- versus error management (p.25)</p> <p style="text-align: center;"><u>Hamond</u> Feedback on elements of piano performance: Two case studies in higher education studio (p.25)</p>	<p style="text-align: center;"><u>THEMATIC SESSION</u></p> <p style="text-align: center;">Perspectives on performance</p> <p style="text-align: center;"><i>Chair:</i> Rosie Perkins</p> <p style="text-align: center;">Fanny Mendelssohn Saal</p> <p style="text-align: center;"><u>Araújo, Cruz, Almeida</u> Managing social interactions: Psychological skills of excellent dancers (p.26)</p> <p style="text-align: center;"><u>Doyle</u> The multiple realities of actors in rehearsal (p.26)</p> <p style="text-align: center;"><u>Cruz, Lourenço, Ferreira-Lopes</u> Reading and understanding performers through critics, or vice versa (p.26)</p>
13:15-14:45	<p style="text-align: center;">LUNCH</p> <p style="text-align: center;">Courtyard <i>and</i> Cafeteria</p>		

14:45-16:15	<p><b><u>THEMATIC SESSION</u></b> Capturing musical movement</p> <p><i>Chair:</i> Richard Parncutt Joseph Haydn Saal</p> <p><u>Nakamura, Goda et al.</u> Effect of daily piano practice on finger kinematics and muscular load (p.27)</p> <p><u>Ohsawa, Obata et al.</u> Memory of the piano key positions in pianists (p.27)</p> <p><u>Lee, Tominaga et al.</u> Frequency of coactivation of arm muscles in primary bowing tremor (p.27)</p>	<p><b><u>THEMATIC SESSION</u></b> Performance education II</p> <p><i>Chair:</i> Philip Fine Clara Schumann Saal</p> <p><u>Manhas, Chindmes</u> Instrumental lessons in pairs: Learning and/by performing together (p.27)</p> <p><u>Ginsborg, Chaffin et al.</u> Reconstructing Schoenberg: Rehearsing and performing together (p.28)</p> <p><u>Ginsborg, Prior</u> “Let’s go again from the top”: The role of collaborative rehearsal in learning music (p.28)</p>	<p><b><u>THEMATIC SESSION</u></b> The science of dance I</p> <p><i>Chair:</i> Emma Redding Fanny Mendelssohn Saal</p> <p><u>Naalchigar, Dimitriou et al.</u> Body composition and injuries in professional ballet dancers (p.28)</p> <p><u>Wyon, Smith, Koutedakis</u> A comparison of strength and stretch interventions on active and passive ranges of movement in dancers (p.28)</p> <p><u>Wyon, Wolman et al.</u> Dancing in the dark: The effect of vitamin D status on muscle function and injury incidence (p.29)</p>
16:15-16:45	<p>BREAK (with refreshments)</p> <p>Entrance Hall and Haydn Saal Foyer</p>		
16:45-18:15	<p><b><u>THEMATIC SESSION</u></b> Approaches to motor learning</p> <p><i>Chair:</i> Sofia Dahl Joseph Haydn Saal</p> <p><u>Araújo</u> Development of a measure of self-regulated practice behavior in skilled performers (p.29)</p> <p><u>Ritchie, Kearney</u> Transfer of practice strategies: From primary to secondary instrument (p.29)</p> <p><u>Bangert, Wiedemann, Jabusch</u> When less of the same is more: Benefits of variability of practice in pianists (p.29)</p>	<p><b><u>THEMATIC SESSION</u></b> Performance education III</p> <p><i>Chair:</i> Dianna Kenny Clara Schumann Saal</p> <p><u>Stambaugh</u> Promoting schema formation among wind musicians of varying abilities (p.30)</p> <p><u>Aggett</u> Simply the best: Presenting Australian art song pedagogical performer’s analyses to singing teachers (p.30)</p> <p><u>Cunha, Carvalho</u> The Orff-Schulwerk approach and optimal experiences: A case study in a music education context (p.30)</p>	<p><b><u>THEMATIC SESSION</u></b> The science of dance II</p> <p><i>Chair:</i> Emma Redding Fanny Mendelssohn Saal</p> <p><u>Xarez</u> Entrainment in ballroom dances: The influence of the pair in the synchronization with the music (p.31)</p> <p><u>Liiv, Wyon et al.</u> Anthropometry and body figure in dance: Comparison between dance styles (p.31)</p> <p><u>Brown, Wyon</u> Dietary and lifestyle patterns of pre and professional dancers: An international survey (p.31)</p>
18:15-18:30	BREAK		
18:30-	<p>CONCERT</p> <p><i>To feature:</i> Musicians of the mdw International Summer Academy Joseph Haydn Saal</p>		

## Thursday, 29 August 2013

08:30-09:00	<p>REGISTRATION</p> <p>Entrance Hall</p>		
09:00-10:30	<p><b><u>SYMPOSIUM</u></b></p> <p>Insights into sound practice: A national study of Australian orchestral musicians</p> <p><i>Chair:</i> Werner Goebel Joseph Haydn Saal</p> <p><u>Ackermann, Driscoll, Kenny</u> Physical characteristics of professional orchestral musicians: Results from a national survey and physical evaluation research project (p.34)</p> <p><u>Kenny, Driscoll, Ackermann</u> Psychological wellbeing in professional orchestral musicians in Australia (p.34)</p> <p><u>Driscoll, Ackermann, Galbraith</u> Surveillance of musculoskeletal disorders and risk factors in orchestral musicians (p.34)</p>	<p><b><u>THEMATIC SESSION</u></b></p> <p>Performance practice</p> <p><i>Chair:</i> Rosie Perkins Clara Schumann Saal</p> <p><u>Wesolowski</u> A microstructural investigation into jazz syncopation: The effects of selected musical variables on note dynamics (p.35)</p> <p><u>Bangert, Fabian, Schubert</u> Doing without thinking? Aspects of musical decision- making revisited (p.36)</p> <p><u>McMahon</u> Dialogue and collective interaction: Informants upon the collaborative interpretation of Baroque performance practice (p.36)</p>	<p><b><u>THEMATIC SESSION</u></b></p> <p>Performing together I</p> <p><i>Chair:</i> Jane Ginsborg Fanny Mendelssohn Saal</p> <p><u>Wöllner</u> Speaking with one voice? Ensemble members' audiovisual perceptions of each other's performances (p.36)</p> <p><u>Marchini, Papiotis, Maestre</u> Investigating the relationship between expressivity and synchronization in ensemble performance: An exploratory study (p.36)</p> <p><u>Biasutti, Concina et al.</u> Behavioral coordination among chamber musicians: A study of visual synchrony and communication in two string quartets (p.37)</p>
10:30-11:00	<p>BREAK (with refreshments)</p> <p>Entrance Hall and Haydn Saal Foyer</p>		
11:00-12:30	<p><b><u>SYMPOSIUM</u></b></p> <p>Insights into sound practice (cont.)</p> <p><i>Chair:</i> Werner Goebel Joseph Haydn Saal</p> <p><u>O'Brien, Driscoll, Ackermann</u> Noise exposure and attitudes to hearing protection in orchestral brass musicians (p.34)</p> <p><u>Chan, Driscoll, Ackermann</u> Can experienced observers detect postural changes in professional musicians after interventions? (p.35)</p>	<p><b><u>THEMATIC SESSION</u></b></p> <p>Career perspectives</p> <p><i>Chair:</i> Amanda Glauert Clara Schumann Saal</p> <p><u>Coffey, Bennett</u> Constructing an artistic identity two careers at a time: Dance and the career lifecycle (p.37)</p> <p><u>Mor</u> Life after performance: The subjective experience of musicians who undergo career transition (p.37)</p>	<p><b><u>THEMATIC SESSION</u></b></p> <p>Performing together II</p> <p><i>Chair:</i> Jane Ginsborg Fanny Mendelssohn Saal</p> <p><u>Corvisier, Corvisier</u> Ravel's <i>Introduction et Allegro</i>: The issue of pedaling in piano duet performance (p.38)</p> <p><u>Schober, Spiro</u> How much do jazz players share understanding of their performance? A case study (p.38)</p>

11:00-12:30	<p><u>SYMPOSIUM</u> (cont.) Joseph Haydn Saal</p> <p><u>Kenny, Ackermann</u> Depression and music performance anxiety are associated with severity of performance related musculoskeletal pain in professional orchestral musicians (p.35)</p>	<p><u>THEMATIC SESSION</u> (cont.) Clara Schumann Saal</p> <p><u>Atkins</u> Occupational health and wellbeing in the UK conservatoire sector: Staff perspectives (p.38)</p>	<p><u>THEMATIC SESSION</u> (cont.) Fanny Mendelssohn Saal</p> <p><u>Bisesi, MacRitchie, Parncutt</u> Structural communication in piano duos: Musical compatibility and individual differences in interpretation (p.38)</p>
12:30-14:00	<p>LUNCH Courtyard <i>and</i> Cafeteria</p>		
14:00-15:00	<p>KEYNOTE ADDRESS Peter E. Keller University of Western Sydney Musical ensemble performance: A theoretical framework and empirical findings on interpersonal coordination (p.39) <i>Chair:</i> Reinhard Kopiez Joseph Haydn Saal</p>		
15:00-15:15	<p>BREAK (with refreshments) Entrance Hall <i>and</i> Haydn Saal Foyer</p>		
15:15-16:45	<p><u>THEMATIC SESSION</u> Brass and woodwind research <i>Chair:</i> Bronwen Ackermann Joseph Haydn Saal</p> <p><u>Hofmann, Goebel et al.</u> Zooming into saxophone performance: Tongue and finger coordination (p.39)</p> <p><u>Bertsch</u> Tonguing on brass instruments: Tempo and endurance (p.39)</p> <p><u>Steinmetz, Altenmüller, Delank</u> Embouchure problems in professional brass players (p.39)</p>	<p><u>THEMATIC SESSION</u> Performance anxiety <i>Chair:</i> Aaron Williamon Clara Schumann Saal</p> <p><u>Osborne</u> Maximizing performance potential: The efficacy of a performance psychology program to reduce music performance anxiety and build resilience in adolescents (p.40)</p> <p><u>Ray, Kaminski et al.</u> Performance psychology information impact on stress and anxiety level of Brazilian music performers (p.40)</p> <p><u>Farnsworth-Grodd, Cameron</u> Mindfulness and the self-regulation of music performance anxiety (p.40)</p>	<p><u>THEMATIC SESSION</u> Performing together III <i>Chair:</i> Elena Alessandri Fanny Mendelssohn Saal</p> <p><u>Gualda, Wagner</u> Emotional communication among performers: Modeling the affective experience as portrayed and perceived emotions (p.41)</p> <p><u>Waddington</u> Co-performer empathy and peak performance in expert ensemble playing (p.41)</p> <p><u>Facchini, Harper et al.</u> Beating together: A case study of heart rate in partner change in violin and piano duo (p.41)</p>

16:45-17:00	BREAK		
17:00-17:45	<p>GRADUATE AWARD PAPER</p> <p>Friedrich Platz Hanover University of Music, Drama, and Media The influence of performers' stage entrance behavior on the audience's performance elaboration (p.41)</p> <p><i>Chair:</i> Aaron Williamon Joseph Haydn Saal</p>		
17:45-19:00		<p><u>WORKSHOP</u></p> <p>The actor becomes Clara Schumann Saal</p> <p><u>Rivera</u> This workshop analyzes theories of Western theatrical culture and psychology (p.42)</p>	<p><u>WORKSHOP</u></p> <p>The craft of collaboration Fanny Mendelssohn Saal</p> <p><u>van Rosmalen</u> This workshop discusses exploratory, theoretical, and artistic work on bringing professionals from arts, business, science, and non- profit organizations together (p.42)</p>





## Friday, 30 August 2013

08:30-09:00	REGISTRATION Entrance Hall
09:00-10:00	KEYNOTE ADDRESS Alan M. Wing University of Birmingham Follow my leader? String quartet synchronization (p.44) <i>Chair:</i> Werner Goebel Joseph Haydn Saal
10:00-10:30	BREAK (with refreshments) Entrance Hall <i>and</i> Haydn Saal Foyer
10:30-11:30	POSTER SESSION Entrance Hall  <u>Aiba, Tsuzaki <i>et al.</i></u> Effects of musical experience on synchrony judgment accuracy: Taking into consideration its relation to cochlear delay (p.44)  <u>Ascenso, Perkins</u> “The more the merrier”? Understanding the wellbeing of professional musicians in collaborative and solo work settings (p.44)  <u>Berg, Silveira Costa</u> <i>The Imaginary Bird</i> : A dialogic performance in a contemporary music for solo flute (p.44)  <u>Bodnar</u> The effect of intentional, preplanned movement on novice conductors’ gesture (p.45)  <u>Cammett, Joobeen</u> Scratching that creative itch: The amateur choir and orchestra as examples of the learning-creative organization (p.45)  <u>Chincharauli</u> Chamber-instrumental interpretation issues on examples of Prokofiev’s chamber sonatas (p.45)  <u>Corvisier, Berg, Prado</u> Performance dialogisms in two Brazilian art songs by Silvia Berg (p.45)  <u>Fine, Friedlander</u> Cryptic crossword expertise and fluid intelligence (p.46)  <u>Hadjakos</u> SmartSense: Using your smartphone for music performance research (p.46)  <u>Hasanoglu</u> Piano education: Purposes and ways (p.46)  <u>Héroux, Fortier, Laurence</u> How to explain the process of creating a musical interpretation: The development of a methodology (p.47)  <u>Hirano, Ohsawa <i>et al.</i></u> French horn embouchure: An electromyographic and facial kinematic study (p.47)  <u>Illes</u> Upgrading creativity: Dynamics of acting in groups (p.47)  <u>Jensen, Frimodt-Møller</u> Model and analysis of individual rehearsals (p.47)

10:30-11:30	<p style="text-align: center;">POSTER SESSION (cont.)</p> <p><u>Kawakami, Mito <i>et al.</i></u> Acceleration of dance movements: The master and a disciple of Nihon Buyo (p.48)</p> <p><u>Kawase</u> Assignment of leadership role changes performers' gaze behavior during piano duo performances (p.48)</p> <p><u>Kawashima</u> Understanding relationships between music and EFL learning (p.48)</p> <p><u>Korte, Perkins, Williamon</u> Learning to perform in older adulthood: Implications for physical and mental wellbeing (p.48)</p> <p><u>Lisboa, Chaffin <i>et al.</i></u> Flexibility in the use of shared and individual performance cues in duo performance (p.49)</p> <p><u>Matović, Peković</u> New limits of musical art expression: Serbian concept of interaction in the classical art form (p.49)</p> <p><u>Mito, Kawakami <i>et al.</i></u> The relation between the key and performance motion on the keyboard instrument (p.49)</p> <p><u>Mukai, Kawakami <i>et al.</i></u> Embodying and learning individual creative methods: Sharing ideas and images for the interdisciplinary collaboration art project (p.49)</p> <p><u>Nagashima</u> Comprovisession: Improvisational realtime composing environment for multimedia session performance (p.50)</p> <p><u>Nakahara, Furuya <i>et al.</i></u> Exercise physiology of piano playing (p.50)</p> <p><u>Obata, Nakahara <i>et al.</i></u> An electromyographic study of the left hand in violin playing (p.50)</p> <p><u>Petrovic</u> Music and speech performance: Music characteristics of Serbian accents (p.50)</p> <p><u>Podnar, Bertsch</u> Infrared thermography as diagnostic tool for physiotherapeutic taping support of musicians (p.51)</p> <p><u>Roussou</u> An exploration of the pianist's multiple roles within the duo chamber ensemble (p.51)</p> <p><u>Shinoda, Mizutani <i>et al.</i></u> Classification and visualization of dance movements of Nihon Buyo using motion capture system (p.51)</p> <p><u>Silva, Soares <i>et al.</i></u> Performing together? A case study of physiological stress between soloist and audience (p.51)</p> <p><u>Stambaugh</u> A comparison of practice on a MIDI wind controller to practice on single-reed instruments (p.51)</p> <p><u>Sulpicio, Sulpicio</u> Trumpet and marimba: Combining sounds in Brazilian music (p.52)</p> <p><u>Tsuzaki, Ue <i>et al.</i></u> Effects of physical training on the stability of operatic singing: Acoustical analyses and physical measurements after isometrics (p.52)</p>
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10:30-11:30	<p>POSTER SESSION (cont.)</p> <p><u>Williamon, Aufegger, Eiholzer</u> Simulating and stimulating performance: Designing and validating simulated music performance settings (p.52)</p> <p><u>Winter, Gualda</u> Preferences in practicing chamber music (p.52)</p>		
11:30-13:00	<p><u>THEMATIC SESSION</u></p> <p>Ensemble synchronization</p> <p><i>Chair:</i> Laura Bishop Joseph Haydn Saal</p> <p><u>Himberg, Spiro</u> Patterns of entrainment: Being out of sync, in sync, and in between (p.53)</p> <p><u>Papiotis, Marchini, Maestre</u> Multidimensional analysis of interdependence in a string quartet (p.53)</p> <p><u>Timmers, Endo, Wing</u> Temporal coordination in string quartet performance (p.53)</p>	<p><u>THEMATIC SESSION</u></p> <p>Analyzing musical movement</p> <p><i>Chair:</i> Jennifer MacRitchie Clara Schumann Saal</p> <p><u>Miura, Schoonderwaldt et al.</u> Is emotional drumming realized in both sound and movement? (p.53)</p> <p><u>Liu</u> Characterizing violin glides in cadential versus noncadential sequences in solo Bach (p.54)</p> <p><u>Rickert, Halaki et al.</u> The use of fine-wire EMG to investigate the kinematics of cello bowing: The results of a pilot study (p.54)</p>	<p><u>THEMATIC SESSION</u></p> <p>Perception of pitch</p> <p><i>Chair:</i> Philip Fine Fanny Mendelssohn Saal</p> <p><u>Parncutt, Hair</u> Intervals as distances, not ratios: Evidence from tuning and intonation (p.54)</p> <p><u>Vurma</u> Does practice affect timbre-induced pitch shift? (p.54)</p>
13:00-14:30	<p>LUNCH</p> <p>Courtyard and Cafeteria</p>		
14:30-16:00	<p><u>THEMATIC SESSION</u></p> <p>Performance health and wellbeing I</p> <p><i>Chair:</i> Aaron Williamon Joseph Haydn Saal</p> <p><u>de Lisle, Speedy, Thompson</u> Vibrato retraining of a cellist suffering from musician's dystonia: A collaborative approach (p.55)</p> <p><u>Clark, Holmes et al.</u> Pointing to performance ability: Examining hypermobility and proprioception in musicians (p.55)</p>	<p><u>THEMATIC SESSION</u></p> <p>Techniques for memorizing performance</p> <p><i>Chair:</i> Wilfried Kausel Clara Schumann Saal</p> <p><u>Foletto, Carvalho, Coimbra</u> Retrieval cues as a teaching tool in one-to-one instrumental lessons: A pilot study (p.55)</p> <p><u>Lisboa, Chaffin, Demos</u> Recording thoughts as an aid to memorization: A case study (p.56)</p>	<p><u>SYMPOSIUM</u></p> <p>Timing and dynamics in Mande ensemble drumming: Metric well-formedness and perception-action coupling</p> <p><i>Chair and discussant:</i> Peter Keller Fanny Mendelssohn Saal</p> <p><u>Polak, London</u> Mande ensemble drumming: An introduction to <i>Ngòn</i> (p.56)</p> <p><u>London, Polak</u> Microtiming in <i>Ngòn</i>: Categorical production and perception of a non-isochronous meter (p.56)</p>

14:30-16:00	<p><u>THEMATIC SESSION</u> (cont.) Joseph Haydn Saal</p> <p><u>Trouli, Bird, Riley</u> Performance measures in pianists: A method of enhancing communication with clinicians (p.55)</p>	<p><u>THEMATIC SESSION</u> (cont.) Clara Schumann Saal</p> <p><u>Gerling, dos Santos</u> Mapping the strategies employed by piano students during memorized performance (p.56)</p>	<p><u>SYMPOSIUM</u> (cont.) Fanny Mendelssohn Saal</p> <p><u>Keller</u> Symposium discussion</p>
16:00-16:30	<p>BREAK (with refreshments) Entrance Hall <i>and</i> Haydn Saal Foyer</p>		
16:30-18:00	<p><u>THEMATIC SESSION</u> Performance health and wellbeing II <i>Chair:</i> Matthias Bertsch Joseph Haydn Saal</p> <p><u>Ginsborg, Hopkins <i>et al.</i></u> Interactive performance: Toward the use of vibrotactile technology by musicians with hearing impairments (p.57) <u>Fulford, Ginsborg</u> The effects of hearing impairment on interactive performance: Two observational experiments (p.57) <u>Evans, Driscoll, Ackermann</u> How to identify and manage stress VPI: Recommendations for wind instrumental teachers and students (p.57)</p>	<p><u>THEMATIC SESSION</u> Evaluating music performance <i>Chair:</i> Masanobu Miura Clara Schumann Saal</p> <p><u>Van Zijl, Luck</u> Thoughts in concert: A multi-method approach to investigate the effect of performers' focus of attention (p.58) <u>Alessandri, Eiholzer, Williamon</u> Between producers and consumers: Critics' role in guiding listeners' choices (p.58) <u>Morijiri</u> Pianists' perceptions on performance criteria: Results of a factor analysis (p.58)</p>	<p><u>THEMATIC SESSION</u> The science of dance III <i>Chair:</i> Liliana Araújo Fanny Mendelssohn Saal</p> <p><u>Pickard</u> Pain, pleasure, and performance: Embodied identity of young dancers and musicians (p.58) <u>Clarke, Wyon, Percival</u> Controlling balance: Static and dynamic balance within dance populations (p.59)</p>
18:00-19:30	BREAK		
19:30-	<p>CONFERENCE DINNER Vienna City Hall</p> <p>The City Hall is one of the most splendid among the numerous monumental buildings along Vienna's Ringstrasse. Designed by Friedrich Schmidt (1825-1891), it was erected between 1872 and 1883, for which the architect orientated himself on a neo-gothical style with a tower similar to gothic cathedrals.</p> <p>Lichtenfelsgasse 2, 1082 Vienna</p>		

## Saturday, 31 August 2013

08:30-09:00	<p>REGISTRATION</p> <p>Entrance Hall</p>		
09:00-10:30	<p><b><u>SYMPOSIUM</u></b></p> <p>The collaborative space: Directing performers' awareness via creative role-play</p> <p><i>Chair:</i> Stephen Johns Joseph Haydn Saal</p> <p><b><u>Blier-Carruthers</u></b> The studio experience: Control and collaboration (p.62)</p> <p><b><u>Barker, Coombs</u></b> The actor at the piano (p.62)</p> <p><b><u>Glauert, Setiadi</u></b> Listener enactments in song without a singer (p.62)</p>	<p><b><u>THEMATIC SESSION</u></b></p> <p>Piano performance I</p> <p><i>Chair:</i> Cristina Gerling Clara Schumann Saal</p> <p><b><u>Shoda, Adachi</u></b> The pianist's acoustical and emotional expressions in the live performance of Schumann's <i>Träumerei</i> (p.62)</p> <p><b><u>MacRitchie, Eiholzer</u></b> Playing hands together: Exploring the use of asynchrony as an expressive device (p.63)</p> <p><b><u>Jabusch, van Vugt et al.</u></b> Piano playing and chronotype: Chronobiological influences on sensorimotor precision in pianists (p.63)</p>	<p><b><u>THEMATIC SESSION</u></b></p> <p>Modeling and analyzing improvisation</p> <p><i>Chair:</i> Bruno Gingras Fanny Mendelssohn Saal</p> <p><b><u>Norgaard, Montiel, Spencer</u></b> Chords not required: Incorporating horizontal and vertical aspects independently in a computer improvisation algorithm (p.63)</p> <p><b><u>Noy, Rinott, Avni</u></b> Ambient auditory feedback promotes synchronized improvisation (p.64)</p> <p><b><u>Himberg, Thompson, Gill</u></b> Rhythmic entrainment in communicative, dyadic improvisation (p.64)</p>
10:30-11:00	<p>BREAK (with refreshments)</p> <p>Entrance Hall and Haydn Saal Foyer</p>		
11:00-12:30	<p><b><u>THEMATIC SESSION</u></b></p> <p>Creating collaborative performance</p> <p><i>Chair:</i> Michael Schober Joseph Haydn Saal</p> <p><b><u>Fine, Vajsbaier</u></b> How good are groups at estimating time? (p.64)</p> <p><b><u>Hill</u></b> The collective choral voice: Artistic impact on young singers of newly composed music (p.64)</p>	<p><b><u>THEMATIC SESSION</u></b></p> <p>Piano performance II</p> <p><i>Chair:</i> Ângelo Martingo Clara Schumann Saal</p> <p><b><u>Pipa</u></b> Fingers as individuals: The pianist's art of choosing the right fingering (p.65)</p> <p><b><u>Parncutt</u></b> Piano touch, timbre, ecological psychology, and cross-modal interference (p.65)</p>	<p><b><u>THEMATIC SESSION</u></b></p> <p>Analyzing the performance of contemporary music</p> <p><i>Chair:</i> Werner Goebel Fanny Mendelssohn Saal</p> <p><b><u>de Assis</u></b> Exploring multi-temporalities: An orchestration of Luigi Nono's .....<i>sofferte onde serene</i>... (p.66)</p> <p><b><u>Giorgio, Imberty et al.</u></b> The role of texture and musicians' interpretation in understanding atonal music: Two behavioral studies (p.66)</p>

11:00-12:30	<p><u>THEMATIC SESSION</u> (cont.) Joseph Haydn Saal</p> <p><u>Bonshor</u> Collaboration in the choral context: The contribution of conductor and choir to collective confidence (p.65)</p>	<p><u>THEMATIC SESSION</u> (cont.) Clara Schumann Saal</p> <p><u>James, Cook</u> A sustainable playing technique for piano performance: Movement science and implications for curricula (p.65)</p>	<p><u>THEMATIC SESSION</u> (cont.) Fanny Mendelssohn Saal</p> <p><u>Bennett, Blom</u> Collaborative understandings in the preparation of a new work for viola and piano (p.66)</p>
12:30-14:00	<p>LUNCH Courtyard <i>and</i> Cafeteria</p>		
14:00-15:30	<p><u>THEMATIC SESSION</u> The science of singing <i>Chair:</i> Gregor Widholm Joseph Haydn Saal</p> <p><u>Onofre, Ricz et al.</u> Effect of singing training on total laryngectomees wearing a tracheoesophageal voice prosthesis (p.67)</p> <p><u>Moorcroft, Kenny, Oates</u> Breathing imagery moderates vibrato rate (p.67)</p> <p><u>Drahan et al.</u> Position of the larynx during lyrical singing in professional and amateur female singers: Preliminary results (p.67)</p>	<p><u>THEMATIC SESSION</u> Theoretical perspectives <i>Chair:</i> Clemens Wöllner Clara Schumann Saal</p> <p><u>MacKie</u> Mirror neurons: Imitation and emulation in piano performance (p.67)</p> <p><u>Martingo</u> Communicating music: Structure, cognition, and expression (p.68)</p> <p><u>Dalagna, Iă, Welch</u> Mental representation of music performance: A theoretical model (p.68)</p>	
15:30-16:00	<p>BREAK (with refreshments) Entrance Hall <i>and</i> Haydn Saal Foyer</p>		
16:00-17:00	<p>KEYNOTE ADDRESS W. Tecumseh Fitch University of Vienna Rhythm, meter, drumming, and dance: A predictive systems view of an ancient aspect of music (p.68) <i>Chair:</i> Roger Chaffin Joseph Haydn Saal</p>		
17:00-17:30	<p>CLOSING REMARKS and ANNOUNCEMENT OF ISPS 2015 Joseph Haydn Saal</p>		

Abstracts  
Wednesday, 28 August 2013

## Keynote paper

### **Dancers: Fit bodies?**

*Emma Redding*

Dancers view themselves as artists not athletes, and for this reason, the physiological development of the dancer's body is addressed to a lesser extent than the dancer's creative and artistic abilities. Dance training can no longer be as reflective of the physiological demands of the dance profession as it was decades ago because the norm for today's dancer is to work within more than one style for more than one choreographer. Although there has been a shift in recent years toward the physiological aspects of the dancer's body through the development of Somatics and Release-based techniques, research shows that dance training (e.g. class and rehearsal) is carried out at a lower intensity than performance—dance is highly skill oriented and requires much time in training for learning and reflection. Lastly, dance is an art form and certain body types appear to be more preferable than others from an aesthetic point of view, even though they may not be as durable from a physiological perspective. For these reasons, the question as to whether dancers are *fit for purpose* is both important and challenging. This article discusses the discrepancies between the changing physiological demands of dance and the current training and education of dancers. The historical developments of the body in dance training and performance are explored, as well as the research around dancers' fitness.

## Thematic Sessions

### **SYMPOSIUM:**

### **CONTROL OF SEQUENTIAL MOVEMENTS IN MUSICAL PERFORMANCE**

#### **Neuronal mechanisms underlying early acquisition and action-monitoring of piano sequences**

*María Herrojo Ruiz and Andrea A. Kühn*

This paper focuses on the neuronal mechanisms underlying the acquisition and monitoring of piano sequences during learning and skilled performance. A brief introduction describes approaches for the analysis of cortical and sub-cortical neurophysiological signals in parallel with the evaluation of performance data. In addition, the results from two studies are presented. In the first, we have demonstrated in 20 healthy pianists and 6 pianists with musician's dystonia the cortical electrophysiological (EEG) mechanisms associated with error-monitoring during overlearned piano performance. In the second, we investigated the role of the human basal ganglia (BG) in the acquisition of novel piano sequences. Here, we used intracranial recordings in the internal globus pallidus, the main motor output structure of the BG, in 10 patients undergoing deep brain stimulation for dystonia while they practiced novel sequences of finger movements on a digital piano. The main outcomes were that the modulation of pallidal oscillatory activity reflected encoding of sequence boundaries, and this effect emerged with training corresponding with improvements in performance. The implications of our findings to understanding the pathophysiology of movement disorders and to music pedagogy and performance are discussed.

#### **Hand motor control in skilled and impaired piano playing**

*Shinichi Furuya and Eckart Altenmüller*

This paper begins by introducing basic methods to record and analyze finger movements and muscular activity in musical performance and then focuses on the two primary issues in hand motor control: independent movement control and coarticulation (i.e. modulation of muscular activity depending on preceding and subsequent motor actions). Time-varying joint angles at fingers and finger muscular activities were recorded by using a data-glove and surface electromyography, respectively, in expert pianists, amateur pianists, and pianists with focal dystonia. The individuated finger movements were maintained across different tempi for healthy pianists but not for pianists with focal dystonia, indicating loss of independent control of fingers in the patients. Finger muscular activity of healthy pianists displayed modulation in response to the upcoming and following key press, indicating forward and backward coarticulation. A prominent difference between the experts and amateurs was evident in the duration of muscular burst, which was narrower for more skilled pianists. In sum, individuated finger movements and coarticulation play roles in accurate and efficient piano performance. Modulation of these motor skills by learning and focal dysto-



nia not only provides information on optimal piano technique and pedagogy but also enables accurate diagnosis of movement disorders caused by piano practice.

### **Using motion capture analysis to characterize skilled cello bowing**

*Julius Verrel and Marjorie Woollacott*

Stringed instrument bowing is a complex skill in which precise movement of the bow is achieved by specific coordination of the degrees of freedom of the right arm. We introduce and apply 3D motion capture methods to analyze two aspects of skilled cello bowing: (1) How are important task variables stabilized during movements? (2) How do expert cellists achieve fast and precise bow reversals? Ten expert cellists and age-matched novices performed repeated continuous (legato) bowing movements. Performance measures included mean and variability of task variables (e.g. bowing angle), range of motion and correlation patterns of joint angles, and velocity and acceleration profiles of bow and arms. During bow movements experts showed more accurate control of task variables and a more distributed coordination, whereas novices mainly used proximal joints. Additionally, experts exhibited more pronounced acceleration patterns at bow reversals, which were characterized by a proximal-distal gradient with earlier and lower-amplitude acceleration peaks at more proximal joints. Expert cellists' performance is based on flexible use and coordination of degrees of freedom. The particular coordination pattern at bow reversals may allow generating high accelerations at the end effector while reducing the required joint torques at the proximal joints.

## **PERFORMANCE EDUCATION I**

### **Theory and practice: A case study of how Schenkerian analysis shaped the learning of Chopin's *Barcarolle***

*Roger Chaffin, Cristina Caparelli Gerling, Alexander Demos, and Andrea Melms*

When confronted by a problem, experts in many fields begin by looking at the "big picture". Experienced musicians do the same when learning a new piece, first forming a "musical image" of the whole piece. What happens when the composer has cleverly obscured the big picture? To find out, we recorded the practice of an experienced pianist and music theorist as she learned Chopin's *Barcarolle* for the first time and then gave ten public performances. Initially, the pianist felt that her practice did not progress and she discontinued work at the piano to undertake a detailed Schenkerian analysis before continuing. Places that the pianist identified as important in the Schenkerian structure she also used as starting places during practice. The effect was present in the initial practice sessions, before the analysis, and later during preparation for public performance. The effect was not present immediately after the analysis while the pianist learned and memorized the piece, when starting places were mainly determined by fingering issues. The big picture shaped practice during the pianist's initial efforts to understand the piece and again during her preparation for performance.

### **Error tolerance and error prevention in music performance: Risk- versus error management**

*Silke Kruse-Weber and Richard Parncutt*

Dealing with errors is a key aspect of music practice, teaching, and performance. Musicians at all levels develop strategies for avoiding errors. Research in pedagogy, psychology, and neuroscience shows that errors can provide useful information for the learning process. But many music teachers aim for errorless learning, focusing on unilateral error control rather than learning through errors. The pursuit of obsessive perfection can block learning processes and development of performance skills. We see a deficit in systematic teaching and learning strategies for dealing with errors when performing and practicing music. Research in instrumental pedagogy has also neglected error issues. We need a "culture of errors" that balances error tolerance (while learning) against error prevention (while performing), and distinguishes risk management (prior to the error) from error management (during and after the error). We advocate approaching performance errors in constructive, creative, differentiated ways. A new theoretical framework could provide orientation for music education at all levels. In an interdisciplinary approach, ideas, data, and practical strategies from other disciplines, such as aviation, have been applied to the training of musicians.

### **Feedback on elements of piano performance: Two case studies in higher education studio**

*Luciana Fernandes Hamond*

Feedback is a crucial component in the change and potential in individual performance. Feedback is both intrapersonal, which happens inside the individual, and interpersonal, such as when it is provided by a teacher or by an additional technology. Types of teacher feedback which are commonly reported in the instrumental learning and

teaching literature are verbal and non-verbal. Technology-based feedback can also be accessed, such as by using a metronome, audio- or video-recording, both in real-time and after the event. Elements of piano performance that have been addressed in research include comments of an expert pianist during the learning process for a new piece, piano performance assessment, and analysis of expert piano performances. Two case studies in different higher education level piano lessons were undertaken. Two student pianists and one piano teacher participated in the study. Two approaches were used for the data collection: video observation and a questionnaire. An analysis involved relating the most observed elements of piano performance to the type of teacher feedback. This was then compared with the students' individual perspectives and the teacher's views on the same student, relating to the most difficult elements of piano performance learning and teaching.

## **PERSPECTIVES ON PERFORMANCE**

### **Managing social interactions: Psychological skills of excellent dancers**

*Liliana S. Araújo, José Fernando A. Cruz, and Leandro S. Almeida*

This study analyzed the psychological skills and processes of excellent dancers in managing social interactions and the emotional demands of performing together. Four contemporary dancers, aged 23-42 years, were nominated by a panel of experts for revealing excellence and agreed to participate in semi-structured interviews. An interview guide was created to explore the personal and social factors in the pathway to excellence. For the purpose of this study, psychological strategies and skills were analyzed, especially those related to performing together. Text coding and analysis was assisted by the computer software MAXQDA. Results demonstrated the importance of setting common goals and the ability to adapt to challenges and cope with others' behaviors and emotions to ensure balanced teamwork. Participants described several strategies to cope with the social and emotional demands of performing dance, including anticipating situations, task focus, self-control, positive self-talk, confidence, and imagery. Results suggested the importance of psychological skills to performing together. Further research is needed to develop new insights into the specific strategies dancers use to manage social interactions and cope with the emotional intensity of performing dance.

### **The multiple realities of actors in rehearsal**

*Charlotte L. Doyle*

In the context of reviewing research on role creation, this paper applies and extends the multiple realities framework. Many independent activities take place in the *actor sphere*: the self-as-actor intentionally carrying out expected activities such as memorizing and script analysis. Other realities include imagined worlds as actors "see" their characters and memory worlds as people once observed are mimicked or past emotional experiences recreated. The collaborative period is crucial. In scene rehearsals a new reality, the *drama world*, emerges. Here, the play's structure and text are taken for granted, yet actors let go of prior intentions and spontaneously interact as characters, sometimes leading to actors' surprise at what they did. Various interruptions, such as felt awkwardness or forgotten lines, dissolve the drama world and reveal actor sphere problems to reflect on. The various worlds interact. Actor sphere and drama world sometimes appear unbidden during everyday tasks and in dreams. The drama world is informed by prior work without being determined by it. Prior work may differentiate and prime actor intentions and character thoughts and feelings, making them available to self-as-character. This framework can be applied to other collaborative arts, promising arenas for its further development.

### **Reading and understanding performers through critics, or vice versa**

*Rui Cruz, Sofia Lourenço, and Paulo Ferreira-Lopes*

Elite piano performances selectively reflect technical and expressive solutions to interpretative problems. These solutions are often credited as features of distinctive "artistry" and biographical "musicianship." A young, skilled, conservatory-trained musician, however, is not an experienced performer, and perhaps the former does not inform the latter, or the latter does not necessarily supersede, or inherit, the former. Recorded evidence, among other things, can reveal that the work of a great performer is not marked by a wholly uniform interpretative style. Therefore, interpretative variety (e.g. renewed performances of the same work) can be assumed by the same performer through a personal filter of interpretative choices and, perhaps, a metaphor of age shift. We believe that we can learn more from prominent performers when highlighting the merits of their performances as tokens of authorial contextual practice, in contrast, perhaps, to the notion of the uniqueness of performers. The aim of this article is to put into question mainstream conceptions concerning performers as individual artists. Three influential artists (Gould, Pollini, Uchida) are examined through biographical impressions, selective recordings, and published interviews.

## CAPTURING MUSICAL MOVEMENT

### Effect of daily piano practice on finger kinematics and muscular load

*Ayumi Nakamura, Tatsushi Goda, Noriko Nagata, and Shinichi Furuya*

The present study aimed at assessing impacts of daily piano practice on kinematics and muscular activity of finger movements while musically-naïve individuals played the piano. Six participants were asked to play a certain melody with metronome with the non-dominant left hand. They practiced fifty trials per day over four successive days. Time-varying joint positions at the hand were recorded using a motion-capture system consisting of 13 high-speed cameras. Extrinsic finger muscular activities were also recorded using a surface electromyography (EMG). The amount of agonist-antagonist muscular co-activation was then computed. The joint angle averaged within each trial was also computed at the MCP, PIP, and DIP joints for each of the fingers. With practicing, the mean angle at the MCP joint became more flexed while the angles at the PIP and DIP joints became more extended. One-way repeated measures ANOVA confirmed significant changes in the joint posture with daily practice. The amount of co-activation of the finger flexor and extensor muscles also displayed a decrease, which indicates a reduction in joint stiffness. This study provided the first evidence demonstrating that daily piano practice reorganizes hand posture in playing and economizes muscular work for stiffening joints.

### Memory of the piano key positions in pianists

*Chie Ohsawa, Satoshi Obata, Takeshi Hirano, Minoru Tsuzaki, Taro Ito, Tadahiko Saito, and Hiroshi Kinoshita*

Accuracy of spatial memory of a piano key was investigated using 14 players with long term (>15 years) training (LT-group) and 13 players with short-term (<13 years) training (ST-group). The experimental task was to move his/her left or right index finger on the target key (C2, C3, E3, A4, C5, or C6 for each hand) position after touching the reference key (C4) position. The experiment was performed using either a real-scale photo copy of a C4 key (the No-keyboard condition) or a photo copy of the whole keyboard, and each was placed on a plain black-cloth-covered table. Kinematics of the fingertip was recorded using a 3D motion capturing system. For the No-keyboard condition, the LT-group had a mean absolute error of  $33.3 \pm 27.4$  mm, while the ST-group had that of  $55.9 \pm 41.5$  mm. The findings indicated that memory of the key position in proficient piano players was not as accurate as expected, though their accuracy was clearly better than less trained players. The right side of the keyboard and the right hand were more accurate than the left side and hand. This could also be related to the effects of training.

### Frequency of coactivation of arm muscles in primary bowing tremor

*André Lee, Kenta Tominaga, Shinichi Furuya, Fumio Miyazaki, and Eckart Altenmüller*

Task-specific tremors (TST) are a tremor entity occurring predominantly during a certain task. In violinists, TST may occur in the right arm while playing the instrument. This primary bowing tremor (PBT) is highly disabling for the affected musician and may threaten his/her professional career. To better understand the pathophysiological mechanism of TST, we measured antagonist EMG-activity to investigate a possible relationship between PBT and coactivation. We found EMG activity specific for PBT in the frequency range of 3-8 Hz as well as coactivation of antagonist muscles in the same frequency range (3-8 Hz) at a mean frequency of 6.6 Hz. Notably we did not find any PBT related EMG activity in at the resonance frequency of the wrist (8-12 Hz). Our findings firstly indicate an association between coactivation and PBT. Secondly, the absence of EMG-activity at the resonance frequency of the wrist indicates that mechanical reflex mechanisms play a less dominant role than central mechanisms.

## PERFORMANCE EDUCATION II

### Instrumental lessons in pairs: Learning and/by performing together

*Allan Duarte Manhas and Olga Chindmes*

Instrumental group lessons have become an increasingly popular alternative in music schools, and in particular in private institutions, where they offer an appealing financial solution for students. However, does this practice only offer financial ease for learning an instrument or does it offer other advantages? What aspects should be taken into consideration when teaching groups? Focusing on instrumental lessons in pairs (in German: *Partnerunterricht*), our study discusses the benefits and shortcomings of this rather underappreciated pedagogical approach. For an examination of the current in-class situation at both public and private music schools in central Germany, we have interviewed teachers, talked to students and their parents, observed lessons, and contacted music schools and their directors for statistical and background information. Our findings indicate that learning with a partner has many more positive aspects than commonly perceived. Moreover, group learning facilitates more intensively and fre-

quently a broad range of musical and social skills. We believe that this study will stimulate teachers to rethink their pedagogical methods and explore this genuinely positive alternative.

### **Reconstructing Schoenberg: Rehearsing and performing together**

*Jane Ginsborg, Roger Chaffin, Alexander Demos, and George Nicholson*

When musicians perform from memory they draw on performance cues (PCs) or landmarks for retrieval. Many of these are prepared in practice but musicians also have spontaneous thoughts when performing. The aim of the present study was to identify the role of both in helping a singer recall a work from memory through analysing her use of musical cues from the accompaniment and verbal cues from the accompanist. Seventeen months after having given a public performance of the work, Schoenberg's Two Songs op. 14, the singer reconstructed and performed them again from memory, first without and then with the piano accompaniment, during the course of a 40-minute rehearsal that was recorded and transcribed. A total of 106 practice segments were analyzed. The singer sang the words and melody, listened to the pianist playing the accompaniment and talked with him in roughly equal proportions (around 30%); she also vocalized the melody. A content analysis of rehearsal talk will be presented. Typical errors included early entries and misremembering the words. While PCs are crucial features of the individual performer's mental representation of the work to be recalled, external cues from accompaniment and accompanist are also invaluable to the musician performing from memory.

### **“Let's go again from the top”: The role of collaborative rehearsal in learning music**

*Jane Ginsborg and Helen Prior*

Research on musicians' practicing and memorizing strategies usually focuses on the individual learner. The aim of the present study was to explore the extent to which students and their tutors report rehearsing with others and consider it to make a contribution to initial learning. Two questionnaire studies were undertaken and qualitative data gathered from tutors who participated in an interactive workshop. The comparison of students' estimated and calculated working time showed that they largely discounted all activities other than solitary practice at the instrument with the score. Nevertheless, nearly 40% of the sample reported rehearsing with others. While few tutors recommended this as a learning strategy, a large minority did rehearse with others themselves. Collaborative rehearsal may play a more valuable role during the early stages of individual learning than students and their tutors realize.

## **THE SCIENCE OF DANCE I**

### **Body composition and injuries in professional ballet dancers**

*Chloë Naalchigar, Moira McCormack, Jackie Pelly, Matthew Wyon, and Lygeri Dimitriou*

Dancers are at a high risk of becoming injured, and most dancers sustain at least one injury per year. Research into injury risk factors is, therefore, imperative in order to identify strategies for prevention. The aim of this study was to examine professional ballet dancers, investigating their bone mineral density (BMD), body composition (lean and fat mass), menstrual history, company position, incidence and severity of musculoskeletal injury, and the relationships among these variables. One hundred and eleven dancers (39 male and 72 female) volunteered for the study. BMD and body composition were measured by DXA. Questionnaires recorded menstrual, medical and family history, medications, use of oral contraceptives, smoking, and alcohol intake. Injury incidence and severity data were collected using physiotherapy records from the two consecutive years following DXA. Statistical analysis was performed using SPSS, with statistical significance set at  $p < 0.05$ . Frequency and severity of injury were not found to be significantly associated with body composition, nor company position. In dancers, where negative mean z-score values at the ultra-distal (UD) radius were observed, their below-normal upper body BMD values may suggest an increased risk of developing osteoporosis, with an associated risk of injury. Results suggest supplemental conditioning, aimed at increasing and maintaining normal levels of upper body BMD, may elicit health and performance benefits for professional ballet dancers.

### **A comparison of strength and stretch interventions on active and passive ranges of movement in dancers: A randomized controlled trial**

*Matthew Wyon, Anna Smith, and Yiannis Koutedakis*

The *grande battement* (PROM) and *développé* (AROM) are integral aspects of dance performance and have been closely linked with artistic virtuoso. The purpose of this study was to assess the effect of three strengthening or stretching interventions on hip and lower limb active (AROM) and passive (PROM) ranges of movement. Thirty-five

female dance students ( $17.00 \pm 0.52$  years,  $61.70 \pm 8.48$  kg,  $164.40 \pm 5.49$  cm) volunteered. They were randomly divided into three groups: strength training ( $n=11$ ), low intensity stretching ( $n=13$ ), and moderate-high intensity stretching ( $n=11$ ). All groups carried out a six week intervention. The strength training group focused on end of range hip flexor strength; the low intensity and moderate intensity stretch group carried out a series of stretches at 3/10 and 8/10 perceived exertion, respectively. AROM and PROM were measured pre- and post-intervention using 2D video analysis. Repeated measures analysis indicated that all three groups improved their PROM (range increase:  $9-20^\circ$ ,  $p < 0.01$ ), and AROM only significantly increased for the strength training and the low-intensity stretch groups ( $p < 0.01$ ). The present data show that non-traditional interventions based on strength training and low intensity stretching are beneficial in the development of both active and passive ranges of movement.

### **Dancing in the dark: The effect of vitamin D status on muscle function and injury incidence**

*Matthew Wyon, Roger Wolman, Yiannis Koutedakis, and Alan Nevill*

As dancers train indoors they are vulnerable to vitamin D deficiency. The aims of the study were two-fold: initially, to evaluate the vitamin D status of elite dancers during winter and summer and assess the impact on bone metabolism and risk of injury; secondly, to measure the effect of oral vitamin D<sub>3</sub> supplementation on muscle function and injury occurrence. Nineteen elite ballerinas volunteered for the first study, 25-hydroxyvitamin D [25(OH)D], PTH, blood serum bone turnover markers, and injury incidence were monitored over a six month period. In the second study, a group of 26 elite classical ballet dancers (intervention  $n=19$ , control  $n=7$ ) had their muscle function measured before and after a four-month oral supplementation of vitamin D<sub>3</sub> (2000 IU per day), and injury data were recorded. Significant changes were noted between the winter and summer test dates for 25(OH)D ( $p < 0.001$ ), PTH ( $p < 0.001$ ), PINP ( $p < 0.01$ ), and injury incidence ( $p < 0.05$ ). In study 2, the intervention group had significant improvements in muscles function ( $p < 0.05$ ) and decreases in injury incidence ( $p < 0.01$ ). There is a high incidence of low vitamin D levels in professional ballerinas which seems to have an effect on bone metabolism, muscle function, and injury incidence. This can be negated by supplementation.

## **APPROACHES TO MOTOR LEARNING**

### **Development of a measure of self-regulated practice behavior in skilled performers**

*Marcos Vinícius Araújo*

The purpose of this study was to develop and test the internal consistency of a self-report instrument for measuring self-regulatory behaviors in skilled performers during practice. 49 classically trained instrumentalists completed a web-based questionnaire designed to assess 5 hypothesized dimensions of self-regulation. Internal consistency was demonstrated through exploratory inter-item and item-total correlational tests. After suggested item deletions, reliability tests revealed that the sub-scales achieved good internal consistency.

### **Transfer of practice strategies: From primary to secondary instrument**

*Laura Ritchie and Phil Kearney*

This study explored the transfer of strategic thinking and self-regulated learning in practice with musicians by observing seven undergraduate music students in practice sessions on both a newly learned instrument and their primary instruments. Students chose how to structure the sessions and were presented with the music, a pencil, and a piano. The timed, recorded practice sessions included a scale and a short, unseen melodic extract. Questionnaire results showed there to be no differences in self-reported goal-orientation, self-satisfaction, global efficacy, or self-efficacy for the two instruments. Although highly individual, both positive and negative observed behaviors such as verbalization, the approach to the material, and even avoidance of certain elements were consistent in both contexts, supporting the transfer of strategies across instruments. This suggests an opportunity for enhancement and acceleration of progress with carefully directed education and conscious application of self-regulation.

### **When less of the same is more: Benefits of variability of practice in pianists**

*Marc Bangert, Anna Wiedemann, and Hans-Christian Jabusch*

Variability of practice has been demonstrated to have beneficial effects for motor skill acquisition, transfer, and retention. This study extends the line of research to musical practice. Pianists were trained to perform a wide interval leap on the piano with their left hand. Performance at the target distance was tested before and after a 30-minute controlled training. One group (FIX) practiced the target interval only. The other group (VAR) received variable training on four different intervals including the target. Transfer was tested on an interval novel to either group.

Retention was assessed in a retest 24 hours later. Leap Distance Error (LDE) and Leap Execution Time (LET) were measured. After training, LDE improved non-significantly in both groups. In the VAR group significant improvement was seen on the next day. This was not the case in the FIX group. In contrast to the FIX group, the VAR group showed significantly faster LET after training compared to baseline, which was stable at retention. The findings are discussed with regard to predictions made by theories of motor learning and implications for musical practice.

### PERFORMANCE EDUCATION III

#### Promoting schema formation among wind musicians of varying abilities

Laura A. Stambaugh

Cognitive load theory identifies three types of cognitive load present during learning: *intrinsic*, *extrinsic*, and *germane*. To optimize learning, cognitive load theory recommends optimizing germane load. The purpose of this study was to examine the interactions among intrinsic and germane cognitive loads when practicing a wind instrument. The study will determine which of two practice strategies is most effective for three levels of learners on a woodwind instrument. Forty-five participants were university music majors and minors with either (1) no experience playing a woodwind instrument, (2) limited experience, or (3) a woodwind major or minor. In a repeated-measures design, students practiced three technical tasks in a random order (high cognitive load) and three technical tasks in a repetitive order (low cognitive load). Participants practiced on a MIDI wind controller, which is similar to a saxophone. Twenty-four hours following practice, participants completed a second study session for retention measurement. Performances were scored for pitch accuracy and speed. Within-subjects comparisons examined which level of cognitive load was most effective for each level learner. Results will be situated in prior research on cognitive load theory, and implications will be drawn for practice.

#### Simply the best: Presenting Australian art song pedagogical performer's analyses to singing teachers

Cathy Aggett

This paper is a report of the third phase of research in a larger study designed to ascertain the most suitable pedagogical issues and frames by which both singers and singing teachers could more easily approach the learning, teaching, and performance of Australian art song. Ten pedagogical analyses of Australian art songs of varying voice types, ability, and styles were written and co-graded by the researcher and a "critical friend" (i.e. another professional singer and singing teacher). Nineteen of 28 professional international singing teachers responded to a "song package" sent to them including a questionnaire, information about the included song with suggested performance strategies, a suggested grading based on the (adapted) Ralston Repertoire Difficulty Index (RRDI), a copy of the score of the song, and a representative recording of it. The questionnaire asked teachers to evaluate the presentation of the analysis, the grading of the song using the information grading sheet, music of the song and the included recording, and to provide some personal details related to their teaching. Eighteen of the teachers agreed that contextual, performative, and pedagogical/musical information, coupled with an accompanying performer's analysis of a song that was graded, was "simply the best" way to pedagogically frame an Australian art song.

#### The Orff-Schulwerk approach and optimal experiences: A case study in a music education context

João C. R. Cunha and Sara Carvalho

This study's main objective was to share results and *Flow Theory*-based analysis of an on-going longitudinal study on music pedagogy and development in a Portuguese music education context. *Optimal experiences/flow states* were experienced by fifth and sixth grade students during music education classes based on the *Orff-Schulwerk* approach. In order to assess musical engagement, questionnaires (based on *AFIMA - Adapted Flow Indicators in Musical Activity*) were given to students. The results obtained were related to the indicator "challenges and skills," which is an *AFIMA* dimension and a fundamental parameter of flow state occurrence. The objective of this longitudinal study was to show that musical activities based on the *Orff-Schulwerk* approach provide a flow-sustaining strategy during music education classes. This research also intends to contribute to an area where information is still scarce on the connection between learning through the *Orff-Schulwerk* approach and the flow-related behaviors of optimal experience. This holistic music learning experience may prove to be important not only in relation to how students acquire music knowledge, but also in how to develop their personalities in a holistic way.

## THE SCIENCE OF DANCE II

### Entrainment in ballroom dances: The influence of the pair in the synchronization with the music

*Luis Xarez*

In personal interactions, such as ballroom dances, there is an element of competition tending to keep the rhythm of each element of the pair (*maintenance tendency*), as well as a component of cooperation (*magnet effect*) and attraction by the rhythm of the other. Not everyone has the same ability to synchronize their movements with timekeepers, such as musical beats. In this study we intended, in a first phase, to measure this ability to change the *spontaneous motor tempo* (SMT) to synchronize the movements of ten different styles of dance with the tempo imposed by a metronome (*compulsory motor tempo*; CMT). Then we intended to verify the influence of the other, in experienced pairs, in the synchronization of the CMT. The results indicated that male participants presented higher SMTs than the female members of the same pair and higher values in *Latin* styles relative to *standard* styles. For the central objective of the study it was found that couples tended to help one another positively when synchronizing with the CMT, with a decrease of 9% of individual mistakes and 18% of mistakes per couple.

### Anthropometry and body figure in dance: Comparison between dance styles

*Helena Liiv, Matthew Wyon, Jarek Mäestu, and Jaak Jürimäe*

Anthropometry in dance and aesthetic sports has been shown to play an important role in selection and performance criteria. The purpose of the present study was to compare anthropometric variables and aerobic capacity between three different groups of dancers: classical ballet, contemporary dance, and DanceSport. Two hundred and eighty six professional dancers from three dance genres took part in the study: 89 ballet, 137 contemporary, and 60 DanceSport. Anthropometric measurements, somatotype characteristics, and aerobic capacity ( $VO_{2max}$ ) were measured. Female contemporary and DanceSport dancers had higher body mass, body fat, and BMI values compared with ballet counterparts. DanceSport participants had significantly lower endomorphy and mesomorphy scores than the other genres. Aerobically, DanceSport had significantly higher  $VO_{2max}$  values compared with ballet dancers. In conclusion, female contemporary dancers are generally more muscular than their ballet counterparts, while DanceSport dancers are taller and heavier, less muscular, and have slightly greater adiposity compared with the classical ballet and contemporary dancers. Ballet dancers had lowest body fat percentage, weight, and BMI values. DanceSport dancers had greater aerobic capacity compared with the ballet dancers.

### Dietary and lifestyle patterns of pre and professional dancers: An international survey

*Derrick D. Brown and Matthew Wyon*

The importance of nutrition in dancers is well established, and its influence on health, lifestyle, body composition, energy availability, and especially dance performance is widely accepted among dance and nutrition scientists. However, the aesthetics of some dance genres expose dancers to body image ideals that may be considered unhealthy and often result in students and professionals taking unnecessary risks to achieve those stereotypes. This study investigated dietary and lifestyle habits in student and professional dancers. 411 participants started this survey, and 350 (F=272, M=78) completed all questions, representing an 81% response rate. Student and professional dancers from 53 countries on five continents completed a cross-sectional survey detailing demography, anthropometry, professional status, dietary patterns, and lifestyle questions. In terms of diet, 35% considered themselves carnivore and 36% omnivore, while 2% were vegan. 30% ingested three or more servings of vegetables per day, 61% reported 1 to 2 servings of protein daily, and 14% ingested no dairy products daily. 62% considered themselves very healthy. These findings suggest no detrimental dietary or lifestyle patterns in this cohort, though continued efforts should be encouraged to educate dancers on more healthful behaviors and lifestyle choices.





Abstracts  
Thursday, 29 August 2013

## Thematic Sessions

### **SYMPOSIUM: INSIGHTS INTO SOUND PRACTICE: A NATIONAL STUDY OF AUSTRALIAN ORCHESTRAL MUSICIANS**

#### **Physical characteristics of professional orchestral musicians: Results from a national survey and physical evaluation research project**

*Bronwen Ackermann, Tim Driscoll, and Dianna Kenny*

Professional orchestral musicians have been reported as having unacceptably high injury rates in a large number of international studies. It is concerning that these relatively consistent high rates of injury have been maintained despite several decades of research, perhaps related to a lack of injury prevention or health intervention studies. The Sound Practice Project answered the call from the government-commissioned Strong report (2005) for the development and implementation of the first-ever national injury surveillance scheme and occupational health and safety initiatives to develop improved policies and practices for orchestral musicians. The starting point for this project was to administer a comprehensive physical and psychological health survey as well as conduct a physical assessment on participating musicians. The physical cross-sectional data revealed high levels of injury across instrumental groups that were not correlated with dysfunction as recorded using traditional physical examination procedures. The findings nonetheless set baseline physical goals that can be useful for rehabilitation, and the reported injury regions have guided the implementation of a series of targeted interventions.

#### **Psychological wellbeing in professional orchestral musicians in Australia**

*Dianna T. Kenny, Tim Driscoll, and Bronwen Ackermann*

We report the major findings from the psychosocial questionnaire component of a cross-sectional population survey of the musicians in Australia's eight full-time professional symphonic and pit orchestras. The response rate was 70% (n=377). Female musicians reported significantly more trait anxiety, music performance anxiety (MPA), social anxiety, and other forms of anxiety and depression than male musicians. The youngest musicians (<30 years) were significantly more anxious compared with the oldest musicians (51+). The youngest female musicians were most affected by MPA. Music performance anxiety was lowest for the older musicians (51+ years). Thirty-three percent (33%) of musicians may meet criteria for a diagnosis of social phobia. Twenty-two percent (22%) answered in the affirmative to a question screening for post-traumatic stress disorder. Thirty-two percent (32%) returned a positive depression screen; this subgroup had higher scores on the anxiety measures. Linear regression analysis identified STAI-T, SPIN, ADD, and age as independent predictors of music performance anxiety severity. Significant numbers of musicians (14%) drank alcohol in a manner outside the NHMRC alcohol guidelines (2009); only 6% were current smokers. This study has identified a significant pattern of anxiety, depression, and health behaviors that require attention in occupational health and safety policies and programs for this workforce.

#### **Surveillance of musculoskeletal disorders and risk factors in orchestral musicians**

*Tim Driscoll, Bronwen Ackermann, and Gary Galbraith*

A surveillance system for musculoskeletal injury and associated possible risk factors in orchestral musicians in Australia was developed as part of the Sound Practice Project. Participants were members of any of the eight main professional orchestras in Australia. Three approaches to surveillance were developed: one paper-based and two web-based. All three essentially asked the same questions. The second web-based system has addressed some of the issues with the earlier two systems and allows regular individual feedback to the participants in order to encourage ongoing participation.

#### **Noise exposure and attitudes to hearing protection in orchestral brass musicians**

*Ian O'Brien, Tim Driscoll, and Bronwen Ackermann*

Among professional orchestral musicians, brass players are exposed to the highest continuous levels of sound in the workplace. Although much of their working life is spent in private practice, little is known about sound level exposure during this activity or the hearing health and hearing conservation practices of this group in particular, making exposure estimation and development of appropriate hearing conservation approaches very difficult. The current study aimed to assess practice room exposure levels, self-reported hearing health, and hearing conservation practices of

this group. Ten professional musicians practicing comparable musical material were assessed for sound exposure and questionnaires were distributed to brass players of eight professional orchestras. Findings indicated brass instrumentalists are likely to exceed acknowledged “safe” sound exposure limits in under an hour of private practice and that, of brass players surveyed (N=65), 50% of those under the age of 50 self-report a hearing loss of some kind while 95% reported the use of hearing protection while playing to be difficult or impossible. Improvements to personal protective devices together with enhanced education for musicians and their teachers, managers, and audiologists is essential to further safeguard the hearing of those in the field and those training to enter it.

### **Can experienced observers detect postural changes in professional musicians after interventions?**

*Cliffon Chan, Tim Driscoll, and Bronwen Ackermann*

Postural dysfunction is reported to increase the likelihood of developing performance-related musculoskeletal disorders in musicians. Both Exercise Therapy and Alexander Technique (AT) use methods that are suggested to assist with improving posture. This study aimed to investigate whether experienced observers were able to detect postural changes in professional orchestral musicians following a 10-week intervention program. 57 musicians volunteered for either a program of Exercise or AT. Standardized series of photographs were taken of each participant before and after participating in an intervention program. Photographs were then randomized by (1) time taken and (2) intervention type. These were evaluated by five experienced musician health professionals and four specialist music educators who had training in AT or Body Mapping. Observers were asked to identify the better posture using anterior and lateral photographic views of each musician. All participants reported an improvement in playing posture post-intervention. Health professionals and music educators identified the true post-intervention photograph as having better posture significantly more frequently than chance (50%). Observers were better able to identify this in the AT group photographs compared to the Exercise group, however this was not statistically significant. Our findings suggest that while experienced observers were able to detect postural changes post-intervention using photographs, further studies could aim to improve findings by increased training and incorporation of video footage.

### **Depression and music performance anxiety are associated with severity of performance related musculoskeletal pain in professional orchestral musicians**

*Dianna T. Kenny and Bronwen Ackermann*

We examined self-reported frequency and severity of performance related musculoskeletal pain (PRMD), trigger point pain (TPP) and depression, social phobia (SPIN), and music performance anxiety (MPA; Kenny Music Performance Anxiety Inventory, K-MPAI) in a cross-sectional survey of 377 professional orchestral musicians. Most (84%) musicians had experienced performance impairing pain; 50% reported current pain. Females reported more performance-impairing pain and more current pain than males. Cluster analysis indicated a complex relationship between depression and PRMD severity. Three clusters showed the hypothesized relationship (i.e. more depression, more pain). Musicians in the fourth cluster denied depression but reported the most severe pain, suggesting a group who somatize their psychological distress. Cluster analysis also revealed a strong relationship between PRMD severity and MPA. Clusters with higher scores on K-MPAI reported higher scores on PRMD severity. TPP was not associated with self-reported PRMD frequency or severity. There was a significant linear relationship between TPP and MPA for females, but males scoring the highest MPA reported lower TPP than those with milder MPA. Neither SPIN nor beta blocker use were associated with PRMD frequency or severity. The complex relationships identified between PRMD, TPP, depression, and MPA may have important implications for PRMD management in professional musicians.

## **PERFORMANCE PRACTICE**

### **A microstructural investigation into jazz syncopation: The effects of selected musical variables on note dynamics**

*Brian C. Wesolowski*

The purpose of this study was to empirically determine what selected musical factors affect the acoustical properties (i.e. note dynamics) of eighth notes in jazz performance. Eighth notes (N=231) were sampled from four unaccompanied solos performed by American saxophonist Chris Potter. Note dynamics were simultaneously regressed on metrical beat placement, melodic character, intervals, articulation, range, underlying harmony, and tempo. The omnibus test was statistically significant, and the predictor variables combined to account for 22.3% of the variance in note dynamics. Tempo was found to have a statistically significant effect on note dynamics.

### **Doing without thinking? Aspects of musical decision-making revisited**

*Daniel Bangert, Dorottya Fabian, and Emery Schubert*

This paper explores how performance decisions are made through an analysis of interviews conducted with 18 Baroque violinists and cellists about their interpretation of solo works by J. S. Bach. Using Interpretative Phenomenological Analysis (IPA), broad themes were found relating to influences on musical decisions and processes of decision-making. Influences were grouped into seven super-ordinate themes: harmony, analysis, physical/technical, historical information, performance context, specific experiences, and repertoire and scores. Many of these themes revealed how performers learn and communicate their knowledge about style. For example, interviewees compared pieces with other Baroque repertoire, referred to historical treatises and different editions, drew on influential performance experiences, and talked about being familiar with the possibilities afforded by the bow and instrument. In the category processes of musical decision-making, most themes related to the meaning, nature, and role of what could be termed intuitive or deliberate processes. Intuitive processes were experienced as a “feeling,” “recognition,” or “sense” based on accumulated experience and knowledge. Deliberate decision-making was discussed in terms of having an awareness and control over a performance, leading to consistency and discipline in executing musical choices. This paper links themes from the interviews to literature on Baroque performance and recent psychological research on judgment and decision-making.

### **Dialogue and collective interaction: Informants upon the collaborative interpretation of Baroque performance practice**

*Paul McMahon*

Baroque composers frequently notated critical aspects of performance practice in minimal fashion, leaving to the performer’s discretion interpretive characteristics that were considered mandatory knowledge for musicians of the time. Yet modern editions often present a diverse variance of scholarly rigor with respect to the interpretation of ornamentation, articulation, tempo, and dynamic inflections. Many of the twenty-first-century practitioners surveyed in this study reported limited formalized theoretical and practical training in Baroque performance practice, with skills instead honed through personal interaction within early professional contexts. Scholars reported upon interpretive guidelines relating to Baroque music as collaborative and artistic mechanisms fundamental to well-versed rehearsal and performance techniques. In light of these scenarios, this qualitative research study reflects upon musicians’ collective interaction. The findings consider the decisive roles played by collaborative discourse and critical listening as procedures inherent to research processes and to rehearsal and performance environs. Furthermore, this paper suggests co-operative dialogue and analytical listening procedures as integral to effective pedagogical settings. Such techniques assist the twenty-first-century musician in engaging with, and adapting to, the enigmatic nature of performance practice within Baroque music.

## **PERFORMING TOGETHER I**

### **Speaking with one voice? Ensemble members’ audiovisual perceptions of each other’s performances**

*Clemens Wöllner*

Successful ensemble performances require a mutual agreement on expressive characteristics of the music. The correspondence between the musicians’ expressive intentions should be manifest in the acoustic and/or visual information conveyed. This study investigated auditory and visual interactions within a string quartet by asking the musicians to play an active role both as performers and in the research. They were filmed during a public performance of Vaughan Williams’ first string quartet in G minor. Some months after the performance, each member of the quartet evaluated the expressiveness of their own and fellow musicians’ performances separately with continuous response ratings for an excerpt from the first movement. Results indicate a general cross-modal agreement on their expressive performance, yet reveal limits to self-other perception and mutual understanding when focusing on each member of the quartet individually. Grand average expressiveness judgments of the music were related to acoustical measures of intensity. Consequences for ensembles without a conductor are discussed.

### **Investigating the relationship between expressivity and synchronization in ensemble performance: An exploratory study**

*Marco Marchini, Panos Papiotis, and Esteban Maestre*

We present an exploratory study on ensemble expressive performance based on the analysis of string quartet recordings. We recorded a piece with three expressive intentions: mechanical, normal, and exaggerated. We made use

of bowing gesture data (bow velocity and force) acquired through a motion tracking system to devise a precise score performance alignment. Individual contact microphone audio signals allowed extraction of a set of audio descriptors for each musician and each note. We show how tempo and loudness on a macro-scale changed across expressive intentions and score sections. The score is also taken into account in the analysis by extracting contextual attributes for each note. We show that micro-deviations were affected by note contextual attributes, whereas the effect of expressive intention varied across sections. We find sections that exhibited a lower entrainment, where individual parts tended to be freer and presented more asynchronies.

### **Behavioral coordination among chamber musicians: A study of visual synchrony and communication in two string quartets**

*Michele Biasutti, Eleonora Concina, David Wasley, and Aaron Williamon*

In ensemble performances, group members may use particular behaviors as a sort of “language” to supplement the lack of verbal communication. These behaviors can be classified into several categories: music regulators, musical expression behaviors, personal needs behaviors, and preparatory and instrumental needs. This study focuses on music regulators, which are defined as signs to the other group members for coordinating the performance: eye contact, smiles, and body movement for attacks and feedback. To understand how regulators are used by ensemble players, video recordings of two string quartet performances were analyzed. Two conditions were considered: a low stress performance (LSP) represented by an ensemble rehearsal, and a high stress performance (HSP) represented by a concert. Findings demonstrated that, during musical performance, eye contact has two important functions: communication between ensemble members and monitoring individual and group performance. It appears strictly related to the score, as it is used to support synchronization, especially in critical technical or rhythmical passages. Movements connected with attacks seem influenced by stressful conditions and by the presence of the audience, conveying both communicative and expressive meanings.

## **CAREER PERSPECTIVES**

### **Constructing an artistic identity two careers at a time: Dance and the career lifecycle**

*Jane Coffey and Dawn Bennett*

The attraction and retention of highly skilled labor is one of the most challenging issues of our time, so much so that labor shortages in many Western nations have fuelled a “war for talent” that increasingly targets retention over initial recruitment. One of the difficulties of retention is that younger workers are increasingly mobile and demonstrate what appears to be a lack of employer loyalty. Not surprisingly, this has prompted calls for a much better understanding of the attraction and retention drivers of young people. Recognizing that, the inclusion of outlier cases has the potential to reveal perspectives not found in more putative cases. This largely theoretical paper contributes insights from research with dancers-in-training. The findings suggest marked differences in the quality of career preview developed by industry-based students and those in higher education. They also suggest that the passion and focus of students may not be an impediment to developing broad views of work and career. The implications for educators center on the need to encourage students to consider possible roles throughout the whole career lifecycle.

### **Life after performance: The subjective experience of musicians who undergo career transition**

*Shulamit Mor*

This study examines the subjective experience of musicians who “closed shop” and moved on to another career. Direct, open-ended, experientially oriented data were collected through interviewing 10 former musicians. The data were systematically analyzed in accordance with the tenets of the grounded theory method and revealed two main groups of participants: “natural” and “ambivalent” musicians. The former group was further subdivided into “injured” and “non-injured” musicians. The core category of the representative model was *Finding Self, Losing Self: Quest for Areté*—a category that illustrates the importance of realizing one’s selfhood through the quest for personal excellence. Subsumed under the core category were four major themes: (1) Unfolding Self: The Making of an Artist; (2) Turning Point: On a Crossroad; (3) Making the Decision; and (4) Looking Ahead: Consequences of Transition. These themes were further divided into subcategories and their properties. Overall, the model presents a holistic perspective of the process of career transition experienced by musicians who retired from the concert stage. In addition, the findings delineate participants’ psychological responses related to identity issues, depending on the specific group of musicians. The model and the findings of the study are discussed within the framework of the organismic valuing theory of growth through adversity.

## **Occupational health and wellbeing in the UK conservatoire sector: Staff perspectives**

*Louise Atkins*

Occupational health and wellbeing for musicians has not historically been a core consideration or component of education within the conservatoire sector. This is, however, beginning to change, and current research acknowledges that educational environments should become increasingly focused on providing students with the tools to sustain lengthy professional careers. The UK conservatoire sector in particular represents a highly competitive set of institutions that have developed unique and distinctive identities and individual approaches to occupational health and wellbeing training and resources. Through a series of semi-structured interviews with 22 staff members from 8 UK conservatories, this research has examined the existing occupational health and wellbeing provisions, activities, and resources and explored the possible future of the topic. The resulting data have revealed wide-ranging and complex occupational health and wellbeing provisions, with each individual describing differing aspects of and purposes for the topic. Institution-wide policy ranged from the highly formalized to the personal and *ad hoc*, even within one institution. When questioned about the future all described a desire for development, but identified several barriers. Many stressed a need for an improved culture where health and wellbeing was incorporated into everyday conservatoire life and was supported and contributed to by all members of staff.

## **PERFORMING TOGETHER II**

### **Ravel's *Introduction et Allegro*: The issue of pedaling in piano duet performance**

*Fernando Corvisier and Fatima Corvisier*

Many authors have discussed the use of pedal in four-hand piano performance, and it is generally understood that the *secondo* player should control it. The main problem when two performers share one instrument is that the player who is handling the pedal must employ it for both himself and his partner, which affects the overall ensemble. In other words, the *secondo* player needs to know both parts thoroughly and listen with extreme care in order to decide how to pedal successfully. Pedal also affects articulation, tone color, clarity of texture, and dynamic nuances. Other important issues include the acoustics of the hall and the quality of the instrument. Both factors vary tremendously, and the pianists should know how to adapt to these conditions prior to their performance. The question of pedaling also has a profound impact on the *primo* player, since performing without operating the pedal affects articulation, attack and release of the keys, and dynamic control. This paper investigates how pedaling should be employed and practiced in Ravel's *Introduction et Allegro*, transcribed for piano duet by Léon Roques, and how it affects the performance.

### **How much do jazz players share understanding of their performance? A case study**

*Michael Schober and Neta Spiro*

To what extent do collaborating musicians need to understand what they are doing in the same way? Two experienced jazz musicians who had never previously played together improvised a jazz standard three times on either side of a visual barrier, and were then interviewed separately about the performances and their musical intentions. Two months later, the performers listened to the recordings and rated the extent to which they endorsed each statement. Performers endorsed statements they themselves had generated more often than statements by their performing partner or an outside expert. The high quality of the performances combined with the disparities in agreement suggest that, at least in this case study, fully shared understanding of what happened is not essential for successful improvisation.

### **Structural communication in piano duos: Musical compatibility and individual differences in interpretation**

*Erica Bisesi, Jennifer MacRitchie, and Richard Parncutt*

Ensemble performance involves each member contributing to a shared interpretation of the piece. In commercial recordings of piano duo performances, this study examined how individual differences in interpretation between each duo affect the rating of salience of particular events (accents), as well as the continuous ratings of phrasing and tension. An example comparing performances of Mozart's Sonata K. 448 Mvt. 3 and Sonata K. 521 Mvt. 2 by duos Argerich/Kissin and Haebler/Hoffman is shown, looking at significant differences in the ratings of events between the two. Differences were more evident between ratings of particular events in the K. 448 extract, which may serve to explain some of the variance seen between the average phrasing profiles.

## Keynote paper

### **Musical ensemble performance: A theoretical framework and empirical findings on interpersonal coordination**

*Peter E. Keller*

Musical ensemble performance requires precise yet flexible interpersonal coordination. The former Max Planck Research Group on Music Cognition and Action investigated the psychological processes and brain mechanisms that enable such coordination. This paper provides an overview of the group's research on factors that determine the quality of ensemble cohesion. First, the theoretical framework and empirical approach that guided our work are outlined, and then key findings are described. These findings address the role of individual differences in cognitive-motor ensemble skills (anticipation, attention, and adaptation), social-psychological factors (personality), and the performer's knowledge about the music and familiarity with co-performers. The paper ends with a discussion of the implications of our research for pedagogical practice aimed at fostering excellence as an ensemble musician.

## Thematic Sessions

### **BRASS AND WOODWIND RESEARCH**

#### **Zooming into saxophone performance: Tongue and finger coordination**

*Alex Hofmann, Werner Goebel, Michael Weilguni, and Walter Smetana*

On the saxophone, the player has to coordinate articulatory tongue actions with the finger movements at the keys. Finger-key actions are used to modulate the sounding frequency. In contrast to clarinet keys, the saxophone key cushion covers the tonehole completely, so the arrival position of the finger to the key does not influence the sound directly. To investigate finger-key interactions, we improved our existing sensor saxophone setup: additional acceleration sensors track the key movements and a webcam captures the left-hand fingerings of the player. Ten graduate saxophonists played a 24-tone melody in a synchronization-continuation paradigm. We calculated the timing precision of each performance from the reed signal. Detailed examination of the recorded videos showed that the fingering positions differ extremely between subjects. Subjects who covered the key pearl with their fingertips completely achieved better results in timing precision than the average group. Although we assume that the saxophone fingering technique influences the performance, we suspect other playing parameters like tonguing, breathing, and embouchure to have more impact on the overall performance quality.

#### **Tonguing on brass instruments: Tempo and endurance**

*Matthias A. Bertsch*

There are countless notes performed daily on brass instruments by beginners and virtuosi. Articulation on brass instruments has been a subject of many method books for centuries, and subsequently qualitative research on their performances have been studied by different visualization techniques. Maximal tempo and endurance for *single tonguing* and *double tonguing* is musically relevant. Quantitative figures were empirically evaluated in this study for the first time with 121 brass players. Maximal tempi showed high inter-individual variability. The average value for *single tonguing* over two seconds was about 121 bpm and slowed down to 103 bpm within 30 seconds of playing. The fastest player performed 167 bpm (eleven notes per second). With *double-single* the mean values were 173 bpm at the beginning and 136 bpm after 30 seconds. The fastest player performed 238 bpm (sixteen notes per second). The level of experience was more relevant than the instrument. For conclusions regarding gender and mother tongue more participants are necessary.

#### **Embouchure problems in professional brass players**

*Anke Steinmetz, Eckart Altenmüller, and Karl-Stefan Delank*

Focal dystonia is a task-specific movement disorder in musicians and has a prevalence rate of 1% to 2% in musicians. In wind players, focal dystonia presents as embouchure dystonia and involves coordination of the embouchure. Data concerning embouchure problems in professional brass players is scarce. Embouchure problems can potentially lead

to focal dystonia. The aim of this study was to investigate the frequency of distinct embouchure problems in professional brass players. Professional orchestral musicians ( $n=585$ ) participated in a cross-sectional study concerning embouchure problems in brass players. A questionnaire was developed evaluating typical signs of embouchure fatigue and embouchure problems. Additionally, practicing habits and coping strategies to overcome the embouchure crisis were collected. Embouchure fatigue was present in 29% of brass players; horn and trumpet players were affected most frequently—33% and 34%, respectively. Embouchure problems were reported by 58% of brass players (64% of trumpet and horn players), and cramping of lips by 13%. The sick leave of musicians suffering from embouchure problems was 16.3%. Mastery of the crisis was claimed by 40% of musicians, whereas 10% reported persisting embouchure problems. The average length of the crisis was 41.33 months. Musicians with embouchure problems were significantly older, played longer in the orchestra, started their instrument later than musicians without embouchure problems, and were used to warming up significantly longer. This study demonstrates the high frequency of embouchure fatigue and embouchure problems in professional brass players. Further studies are warranted to develop screening methods identifying musicians at risk of developing focal dystonia.

## PERFORMANCE ANXIETY

### **Maximizing performance potential: The efficacy of a performance psychology program to reduce music performance anxiety and build resilience in adolescents**

*Margaret S. Osborne*

Music performance anxiety (MPA) can be distressing for many young people studying music, and may negatively impact their ability to cope with the demands and stressors of music education. This is a randomized wait-list control study of a performance psychology program to reduce MPA and promote resilience delivered to adolescents in a school environment. Fifty-five students (12-16 years of age) split across two groups participated in an eight-week program covering concepts of peak performance, personal strengths, planning and goal setting, motivation, positive self-talk, relaxation and visualization, stress regulation, and recovery after disappointments or setbacks. Assessments immediately pre- and post-program and at a two-month follow-up showed a significant reduction in self-reported MPA that continued to decline two months after participating in the program, accompanied by improved self-belief, planning, persistence, and control over successful outcomes, as well as reduced failure avoidance, self-sabotage and disengagement. This study demonstrates the efficacy of these psychological techniques to reduce performance anxiety and improve motivation, engagement and resilience in adolescent music students.

### **Performance psychology information impact on stress and anxiety level of Brazilian music performers**

*Sonia Ray, Leonardo Kaminski, Carlos Fonseca, Rodrigo Dueti, Sergio Rocha, and Paulo Santos*

This work examines the impact of information on music psychology on Brazilian undergraduate and graduate music performance students and its effect on their stress and anxiety levels. It includes an investigation of 15 Brazilian public university curricula based on previous research. The main goals of this study were (1) to investigate how much information on music psychology Brazilian music performance students had access to during their courses and (2) to determinate the impact such information may have on the level of stress and anxiety in the students' performances. Students and teachers from 3 universities of São Paulo State, Brazil were asked to answer three forms: the Kenny Music Performance Anxiety Inventory (K-MPAI), the Inventory of Stress Symptoms LIPP, and an additional form inquiring of the participant's preparation for performance. The study found that information on music psychology is only presented privately at the teacher's discretion. Because there is no formal class on the topic it wasn't possible to infer the results of such a presentation. Just over half of the 191 participants (50.3%) didn't present a stress condition. Almost half of them (49.7%) presented some level of stress.

### **Mindfulness and the self-regulation of music performance anxiety**

*Virginia Farnsworth-Grodd and Linda Cameron*

Mindfulness has gained prominence in alleviating anxiety and improving health outcomes across diverse populations, but little attention has been given to how dispositional and situational levels of mindfulness may leverage musicians' coping efforts to self-regulate experiences of music performance anxiety (MPA). These relationships were investigated in a sample of 159 tertiary music performance students, using self-report measures. Variables were measured at (1) the start of an academic semester, (2) one week prior to final performance exams, and (3) immediately after the performance exam. Regression analyses revealed students' ability to mindfully "act with awareness," and predicted lower levels of MPA across time. Mediation analyses indicated that dispositional mindfulness pre-



dicted greater mindfulness during the performance week through less avoidance of performance-related thoughts and feelings and a greater sense of having agency and resources to meet performance goals. During performance, greater situational mindfulness predicted lower MPA through increased focus on the positive aspects of the performance, greater self-kindness, and self-acceptance. These results support the development and evaluation of mindfulness training in tertiary music curricula and in treatments for MPA.

### PERFORMING TOGETHER III

#### **Emotional communication among performers: Modeling the affective experience as portrayed and perceived emotions**

*Fernando Gualda and Júlio César Wagner*

This paper reports results from listening experiments with live performances, during which the performer conveyed distinct affects for repetitions of the same musical excerpt. Two kinds of experiment were conducted. Pilot studies were designed to test word-based interfaces for marking changes of expression. The main experiment aimed at testing how the performer conveyed his interpretations to 60 listeners, all musicians. Results indicate a bias toward higher valence in the report by the listeners than in the intended affects as conveyed by the performer, as well as an amplification of the values on the arousal axis.

#### **Co-performer empathy and peak performance in expert ensemble playing**

*Caroline E. Waddington*

Optimal experiences of performance are important and desirable. In ensemble playing, these experiences are influenced by a connection between players. The present study sought to explore expert Western art ensemble musicians' experiences of peak performance and co-performer empathy in order to construct a model of the relationship between these phenomena. Focus group interviews were conducted with five expert chamber ensembles. The resulting model showed optimal performance in expert ensemble playing to be a combination of co-performer empathy, components of flow, and performance conditions such as repertoire choice and environment. Co-performer empathy itself consisted of a *shared approach* to interpretation and to working together, an *intentional awareness* of how other players are operating on a musical and a practical level, and a *special connection* between players. Analysis also revealed *spontaneous interpretative flexibility* in performance to be a product of co-performer empathy.

#### **Beating together: A case study of heart rate in partner change in violin and piano duo**

*Fiammetta Facchini, Nancy Lee Harper, Filipa Lã, and Catarina Ricca*

This study looked at physiological responses to stress in musicians, comparing a newly formed and consolidated violin-piano duo. The common element between these duos was the pianist. Using the non-invasive device *VitalJacket®*, developed at the University of Aveiro, Portugal, participants were monitored under various performance conditions. These included two performance venues (university and secondary school), as well as familiar versus unknown repertoire. The latter was given approximately one week before each recital. Results suggested higher heart rate for the school venue and during periods previous to music sections that could offer some technical or musical challenges. The pianist yielded an overall higher heart rate while performing familiar repertoire (regardless of violinist partner) and lowest heart rates before going onstage and playing in the newly formed duo for the beginning of the first recital. Results suggest that both conditions of unknown repertoire and partner in performance may cause higher expectations on the pianist, explaining higher stress indicators such as heart rate.

## Graduate Award Paper

#### **The influence of performers' stage entrance behavior on the audience's performance elaboration**

*Friedrich Platz*

This study proposes a typology of the initial stage entrance behavior of performers based on audience members' first impressions of selected video recordings at an international violin competition. Against the theoretical background of social interaction theory, it is assumed that performance evaluation can only be understood as an interaction between expectations of audience's sub-classes and observable behavior of groups of performers. An analysis of performer behavior was conducted in three steps: (1) based on methods of classical test theory and item response theory,

a selection of six items that best describe performer behavior with regard to the audience's forming an impression was presented, (2) by means of a multi-level latent class analysis, responses could be described by one of three classes of the audience's first impression judgments ("appropriate," "acceptable," and "inappropriate" stage entrance behavior) resulting in two groups of performers' stage entrance behavior evaluation, (3) the association between audience first impression classes and the audience's motivation for performance continuation was used as an indicator for a more in-depth performance elaboration. Results suggest that for the adequate understanding of audiovisual performances, a model of *performance elaboration* can be an alternative to models of musical communication.

## Workshops

### **The actor becomes**

*Diana Rivera*

In Western theatrical tradition, the actor prepares to become a character onstage. The process is an internalization of the personality profile of the character wherein the actor becomes those qualities in order to perform a character, tell a story, and enhance audience belief. Personality psychology suggests a potential for the actor to be vulnerable to diffuse states of self. Does becoming a character onstage change the personality of the actor offstage? How might that change impact his or her personality? This workshop analyzes theories of Western theatrical culture and psychology to suggest vulnerability.

### **The craft of collaboration: Collecting the features**

*Bart van Rosmalen*

In a paper-performance, van Rosmalen will discuss his exploratory, theoretical, and artistic work on bringing professionals from arts, business, science, and non-profit organizations together in what he calls "Connecting Conversations." With an artistic background as a free improvising cellist and director of small scale music theater performances, his fascination for interdisciplinary collaboration was challenged through growing worries around the rather isolated position of the arts in society. Why are the arts not in the center of the knowledge economy and new ideas about entrepreneurship and innovation? Why are the arts rather locked up in highly specialized disciplines, performing in specific venues for fixed audiences? Van Rosmalen develops a collection of forms, exercises, attitudes, and strategies to catalyze collaboration and innovation in the arts and between arts and other disciplines. Re-telling the myth of the muses, nine interdisciplinary collaborative sisters in ancient Greece, is the leading metaphor. Four muse-inspired features frame the collection: (1) fulfilling and feeding the need for *narrative*, (2) an expressive approach to reflection: thinking by *making*, (3) performing the work instead of regular working: *playing*, (4) collective action from a group with articulated individual voices: *sharing*. In line with these findings, the paper will be partly spoken and partly performed in collaboration with visual artist Barbara Philipp.

Abstracts  
Friday, 30 August 2013

## Keynote paper

### **Follow my leader? String quartet synchronization**

*Alan M. Wing, Satoshi Endo, Tim Yates, and Adrian Bradbury*

Timing variations in individual musical performance include both intentional expressive and unintentional error components. Such timing fluctuations contribute to the liveliness of group musical performance but need to be kept under control to create a sense of ensemble. The nature of this control is the focus of this paper. We first report an experiment in which we manipulated visual cues given by violin 1 to the other players in a quartet. We then review a new model of synchronization, and finally we describe a new listening test to determine whether people can distinguish adjustments being used to maintain ensemble synchrony. Such techniques will contribute to understanding of the nature of synchronization in music ensembles.

## Poster Session

### **Effects of musical experience on synchrony judgment accuracy: Taking into consideration its relation to cochlear delay**

*Eriko Aiba, Minoru Tsuzaki, Noriko Nagata, and Seiji Nakagawa*

Musicians are sensitive to the synchrony of multiple tone onsets. However, even when several sounds have a simultaneous onset, their temporal relationship might not be preserved at the cochlear level because of “cochlear delays” in perception. The purpose of this study was to investigate whether cochlear delay significantly affects synchrony judgment accuracy and whether this phenomenon is dependent on musical experience. We conducted a psychoacoustic experiment to measure synchrony judgment accuracy in professional pianists, amateur pianists, amateur instrumental musicians (non-pianists), and non-musically trained people. Our experimental stimuli comprised three types of chirps, which allowed us to control for the amount of cochlear delay. We found that, regardless of the type of instrument, musicians had more accurate synchrony judgment. This may be due to the effect of careful listening, which is required as part of musical training. However, asymmetric aspects of temporal processing in the human auditory system were unaffected by musical experience.

### **“The more the merrier”? Understanding the wellbeing of professional musicians in collaborative and solo work settings**

*Sara Ascenso and Rosie Perkins*

Recognizing the need to include professional musicians in mainstream wellbeing profiling, and to move beyond a focus on the potentially debilitating factors of the music profession, this study aimed to understand how professional musicians experience wellbeing in the light of positive psychology. In particular, acknowledging the role of interpersonal relationships in wellbeing, the goal was to explore wellbeing profiles in relation to collaborative and solo-oriented working contexts. Participants included six professional musicians, three belonging to fixed-group work settings (orchestra, choir, and chamber ensemble) and three engaged in a solo-oriented musical route (soloist, composer, and conductor). Two in-depth interviews were conducted with each participant, separated by a two-week period of individual record-keeping using the Day Reconstruction Method. Results revealed identity as an overarching sustainer of wellbeing. Relationships and “musical moments” emerged as key elements in the construction of wellbeing, while the transition to the professional phase was often challenging. Group identity appeared as a vehicle for wellbeing among the collaborative musicians, although this type of activity also placed demands on social skills. Solo musicians highlighted freedom of expression as a source of purpose although a lack of feedback represented a challenge. Implications are discussed in relation to the role of holistic training in educational settings.

### **The Imaginary Bird: A dialogic performance in a contemporary music for solo flute**

*Silvia Maria Pires Cabrera Berg and Sara Lima da Silveira Costa*

*The Imaginary Bird* for solo flute uses all technical features of the instrument, including the creation of new resources through the use of extended techniques. The flute is itself central to the composition as it becomes the imagi-

nary bird. It takes the warble of the *Uirapurú* bird as the sound source and recreates it as transcription fragments in a plaiting of natural sounds and overtones, using an extensive range of technical approaches. Interpretively, the aims are to solve the composition's complexity, releasing its intellectual energy into a performance with meaningful physicality.

### **The effect of intentional, preplanned movement on novice conductors' gesture**

*Erin N. Bodnar*

Variety and effectiveness of gesture differentiate expert conductors from novice conductors. Preplanning movement in conducting may be one way to widen the student's vocabulary of gesture and promote motor awareness. To test the difference between guided score study and guided score study with preplanned intentional movement on the conducting gestures of novice conductors, undergraduate music students (N=8) were assigned to one of two conditions and then evaluated on their conducting performance. In the first condition (score study with preplanned intentional gestures), students assigned and practiced specific gestures to the articulations, dynamics, cues, texture, and phrase shapes. In the second condition (score study only), students were guided through the piece in terms of form, articulation, dynamics, orchestration, and texture, discussing only the sound of the ensemble. All participants were videotaped conducting the piece with a university instrumental ensemble. Performances were evaluated by two conducting experts on gestures of dynamics, articulation, cues, releases, and phrasing. Analysis of the mean scores for each rating revealed a significant difference ( $p < 0.05$ ) for articulation, cues, releases, and phrasing, with the intentional-movement-participants rating higher than the score-study-only participants. No significant difference was found for dynamics.

### **Scratching that creative itch: The amateur choir and orchestra as examples of the learning-creative organization**

*Kathy Cammett and Alistair Joobeen*

The "right" orchestra or choir conductor is a catalyst for excellence and creativity. The "result" is the performance—group creativity within a complex organization. Business organizations have become increasingly interested in the workings of orchestras and the like, yet there has been little research in the reverse direction. This paper explores lessons of creativity *from* complex organizations *to* ensembles. Part 1 outlines literature survey and statistical methodologies. Part 2 evaluates individual creativity of members of some great orchestras and choirs and continues to explore what happens when "The Creative Organization" merges with "The Learning Organization" to form "The Learning-Creative Organization." Researchers ask, "What is individual versus group creativity, and does one contribute to the other in these ensembles? Does the creative contribution of members decline over time? Is there a new paradigm to stimulate an individual's creativity and contribution to the group? Should conducting be more about new understandings of leadership and teamwork that stimulate the individual's creative contribution?" The purpose of this research is to test The Learning-Creative Organization as a model, coming up with further paradigms for music organizations to tap more deeply into the creativity of each member.

### **Chamber-instrumental interpretation issues on examples of Prokofiev's chamber sonatas**

*Mariam Chincharauli*

The twentieth century was a period of searching, artistic tendencies, and generalization of style. Its characteristic features were the expansion of the information field, the opening of dialogue between styles originated in different epochs, the transformation of old traditional forms, and the generation of new genres. It was important that composers of the twentieth century added new interpretations to content possibilities, while using past genre models. They put a modern person's outlook and a "breath" of social cataclysmic dimensions in their creations using innovative composition techniques and means of performance. In this context it is interesting to study the creations of Sergei Prokofiev, in particular his compositions for chamber ensemble (specifically the chamber sonatas with piano). This research is important as there isn't sufficient information concerning the interaction rules of the expressive means of the piano with other instruments—in this case the violin and flute.

### **Performance dialogisms in two Brazilian art songs by Silvia Berg**

*Fátima M. Corvisier, Silvia Maria Pires Cabrera Berg, and Yuka A. Prado*

Musicians typically perform with other musicians. Vocal solos tend to be with an ensemble, orchestra, quartet, choir, or other accompaniment; rarely are they *a capella*. The aim of this study was to analyze and understand the dialogism through the Bakhtinian philosophical perspective involving composer, pianist, and singer. While most studies

concerning ensemble practices and performances focus on methods and strategies for rehearsing, we examined the entire performance taken together, so that each part is considered only in relation to the whole. We discuss the compositional and performing aspects of two songs: *Oração para Aviadores* (Prayer to Aviator) and *O Amor* (The Love), written for soprano and piano by Brazilian composer Silvia Berg. The process includes the dialogism of the compositional aspects of the two songs, the dialogic flow between the composer and performer, and the dialogic interchange between singer and pianist. As a result, we reveal the singularity of the fusion, immediacy, and impermanence of the songs, and also the grounding experience within musical performance. Moreover, we identify the unique aspects of the composer, performer, and listener within the process.

### **Cryptic crossword expertise and fluid intelligence**

*Philip Fine and Kathryn Friedlander*

Solving cryptic crosswords involves understanding how cryptic clues are constructed, an ability to think laterally and not to be misled by “red herrings,” and a good knowledge of words. As cryptic crossword solvers tend to be educated to at least degree level, often in mathematics and science related disciplines, it is plausible that they have higher than average fluid intelligence (“thinking on one’s feet”). Twenty-eight crossword solvers (18 expert and 10 non-expert) solved a bespoke cryptic crossword and completed the Alice Heim tests of problem solving (AH5), a timed high-grade fluid intelligence test, measuring verbal and numerical (Part I) and non-verbal diagrammatic (Part II) reasoning abilities. In the 45 minutes allowed, 17 experts and 2 non-experts correctly finished the crossword. The experts scored significantly higher on the AH5 overall and on Part I than the non-experts. There was also a significant correlation between finishing time and the Part I AH5 scores for those who finished the crossword: faster finishing times associated with higher AH5 scores. In this case at least, specific psychometric ability does seem to relate to level of expertise. Differences with previous literature on this issue are discussed.

### **SmartSense: Using your smartphone for music performance research**

*Aristotelis Hadjakos*

There has been a wealth of research on musicians’ movements in performance science and musicians’ medicine. Although it is often implied that the results could be interesting for music performers and pedagogues, this research is ignored by most practitioners. One reason might be that today’s musicians have no prior experience with objective movement measurement. Without that, they may find it hard to relate to the results of that research and experience, judging it as too technical. On the other hand, the progress of technology has led to the situation that inertial movement sensors are all around us, e.g. in the smartphones that we carry around. SmartSense is a motion sensing system based on a smartphone, a tablet, and (optionally) a MIDI keyboard attached to a computer. The smartphone is strapped to the player’s arm and provides continuous sensor data. The data is streamed to the tablet where it is visualized. In order to make the system as easy-to-use as possible, the components are discovered automatically on the local wi-fi network. SmartSense provides motion sensing to musicians, who can start to explore their own movements based on introspection and objective motion measurement, so that they, too, can participate and contribute to the field.

### **Piano education: Purposes and ways**

*Olga Hasanoglu*

In this research, the author attempted to foresee the future of some activities involving the piano, relying on examples from its present and past conditions and on statistics from different countries. The main issues that worry pianists and pedagogues today are many, such as the decreasing interest of the concert-going public, a “sportsman-like” approach towards performance by the interpreters, absence of meaning and depth in their interpretations, the beginners’ impatience towards practice, and very low levels of initial and intermediate education in many countries. These factors lead us, the community of professional pianists, to a highly pertinent question: will our profession survive or will we end up without work and, most importantly, without inspiration and demand? This paper is part of a larger work devoted to analysis of the societal attitude towards music in general and the state of pianistic education in Turkey. Also, the fabric of piano repertoire must be compared with modern ideas and thinking and the characteristics of a national approach of the performers from different cultures. The results of such analyses show that piano activity tends to spread to many new areas across the world and has had varying impact on human development.

### **How to explain the process of creating a musical interpretation: The development of a methodology**

*Isabelle Héroux, Marie-Soleil Fortier, and Laurence Lambert-Chan*

Our research aimed to develop a methodology in order to analyze the entire creative process in the work of interpreting a musical piece. We conducted a pilot study with a single case. The first step of our study was to collect our data according to the instrumental work validated by different researchers (rehearsal recordings, verbalization of reflexive questionnaires, observations). Then, we conducted a content analysis of the previously gathered data. As a second step, we used an interview technique inspired by the self-confrontation interview method. All of the data collected were then analyzed through a grounded-theory analysis. Although we used work stages previously mentioned in the scientific literature, we have observed a new work stage we described as *appropriation artistique* or artistic appropriation. In this stage, the subject would associate the abstract sense of musical discourse to his own life experience through the use of analogies and narratives in order to give a more convincing interpretation. The results of our research cannot be generalized, however the methodology developed will lead us, in future research observing several subjects, to study the entire creative process in the work of interpreting an original musical piece.

### **French horn embouchure: An electromyographic facial kinematic study**

*Takeshi Hirano, Chie Ohsawa, Satoshi Obata, Kazutoshi Kudo, Tatsuyuki Ohtsuki, and Hiroshi Kinoshita*

This study investigated embouchure-related muscle activities and related facial skin movement in trained French horn players. In relation to pitch and intensity of tone produced, amplitude of surface electromyogram (EMG) from five selected facial muscles and related facial skin kinematics were examined during pre- and post-attack phases. There was no difference in EMGs and facial kinematics between these two phases, indicating importance of appropriate preparation for embouchure formation. EMGs in all muscles increased linearly with an increase in pitch, and they also increased with tone intensity without interacting with the pitch effect. Facial skin movement remained constant across all pitches and intensities, except for lateral retraction of the lips during high-pitch tone production. These findings indicate that contraction of the embouchure-related muscles is fundamentally isometric for flexible sound parameters in order to modulate lip tension and firmness. Horn players seem to have developed a specialized ability to precisely balance facial muscle contraction with inter-oral pressure.

### **Upgrading creativity: Dynamics of acting in groups**

*Aniko Illes*

The paper aims to examine the role of social factors in the process of creating together in the context of artistic group activities such as performance. The research questions focus on the added value of formatting a group (instead of merely having some people together), the interaction between the participants, and the support and openness of the others. The paper argues on the relevance of social factors such as group dynamics and the support by the group members. The aforementioned factors and features are interpreted by analysis of examples from the field of drama, music, and dance. The analyses make it also clear that group performance can be examined as a creative process. Performing is a creative process heavily influenced by social factors. The process of performing an artwork has a huge complexity. There are many determinants identified. This paper offers a framework to understand the correspondences of the determinant and influencing factors of a successful performance regarding the interpersonal context (relations and the supporting circumstances). The implications to teaching art, music, and drama are also discussed.

### **Model and analysis of individual rehearsals**

*Kristoffer Jensen and Søren Frimodt-Møller*

This work focuses on the quantitative improvement over time made by a musician rehearsing a specific piece of music. In particular, this study considers the attention paid by the musician alternately to the instrument and the score during rehearsal, in order to describe the evolution of this attention over time, and discusses how this attention is dependent on the musician's ability to memorize. A selection of musicians (playing guitar, bass clarinet, or violin) was made to individually rehearse short pieces (by Beethoven and Bach) up to and exceeding 20 times. The musicians were instructed only to look at the instrument or the score when necessary and otherwise to keep their focus on the camera (to emulate the presence of an audience or conductor). This process was annotated and modeled using UML diagrams, in particular the Use Case diagram. The annotation includes the attention to the score and the instrument, respectively, when applicable. Via these observations, hypotheses are formed and discussed regarding the development of a musician's Long Term Memory (LTM) in relation to the score, as well as how much s/he is able to store in Short Term Memory (STM) while playing.

### **Acceleration of dance movements: The master and a disciple of Nihon Buyo**

*Hiroshi Kawakami, Yuki Mito, Toru Ozawa, Yukitaka Shinoda, Toshihiro Irie, and Mieko Marumo*

*Nihon Buyo*, one type of Japanese traditional dance, needs high-level technique. Therefore, the high skill of the master has been the target of this research using motion capture. The dance of Senzo Nishikawa, who is a national living treasure, was analyzed. The purpose was to acquire aesthetic elements by analyzing dance movements. An optical motion capture system was used to study the movements of the master and a disciple. Senzo Nishikawa and his disciple danced a part of *Musume Doujyoji*. The relative acceleration from the sacrum was calculated at five places, as well as the face, hands, and feet, using motion data. As a result of examining five relative accelerations, two differences between the master and his disciple were observed. Firstly, as the maximum acceleration for every choreography was compared, maximum values of the master exceeded the disciple significantly on the accelerations of both hands and feet. Secondly, in a viewpoint of the envelope on the time variation of accelerations, we found a difference in the method of acceleration. In particular, we found a remarkable change of motion in the master's data, which may have affected visual impressions. Since the liveliness of dance motion related to this acceleration, the validity of investigating acceleration change was supported by this research.

### **Assignment of leadership role changes performers' gaze behavior during piano duo performances**

*Satoshi Kawase*

The purpose of the current study was to examine modulation of gazing behavior and synchronization in piano duos under manipulation of the leader/follower relationship. Three pairs of skilled female pianists who were social equals in everyday life participated in the experiment. The primo and secondo players were located in separate soundproof rooms but allowed visual contact through a glass window. The primo and secondo parts did not signify leader and follower. We video-recorded the performance and analyzed each performer's gaze behavior frame-by-frame. Participants played under three conditions: reversed leader/follower role conditions and a control (i.e. without leadership assignment) condition. The results showed that gaze behavior during music performance was altered in the presence of leadership assignments. Followers' and leaders' gaze durations lengthened and shortened, respectively, with respect to the control condition. Mutual gaze just before tempo changes enhanced synchronization regardless of leadership condition. The timing lag between performers under the leader/follower conditions did not significantly differ from that under the control condition. These results suggest that social relationships between performers influence gaze behavior, although they do not significantly affect visual communication strategies for synchronization.

### **Understanding relationships between music and EFL learning**

*Hirokatsu Kawashima*

Music is commonly used in the EFL (English as a Foreign Language) classroom. Although relationships between music and second language learning have been explored, little is empirically understood about relationships between music and EFL learning/teaching. Various types of classroom-based investigations, which target Japanese EFL learners, have been conducted in an attempt to elucidate such relationships, especially focusing upon important learning/teaching elements in the EFL classroom, such as general listening, sound discrimination, and vocabulary learning. It has been found, for example, that (1) there is a statistically significant relationship between the amount of listening to music when learning English and general listening proficiency ( $N=59$ ,  $r=0.39$ ,  $p<0.05$ ) and (2) the combination of three language-related variables (listening-based vocabulary power and perceptual discrimination performance of English vowel and consonant minimal pairs) and one music-related variable (the experience of musical instruments in childhood) generates the highest predictive power to explain the variance of general listening proficiency ( $N=59$ ,  $R^2=0.32$ ,  $p<0.01$ ). In the paper, based upon the results of two classroom-based investigations conducted in 2012 and 2013, the nature of relationships between music and EFL learning/teaching elements, including interactions between music-related and language-related variables, are discussed.

### **Learning to perform in older adulthood: Implications for physical and mental wellbeing**

*Michaela Korte, Rosie Perkins, and Aaron Williamon*

Western society is rapidly changing with the ratio of older adults constantly increasing, making their contributions to society even more vital than before. Therefore, strategies enabling them to maximize their potential of living healthy, independent lives while minimizing the need for long-term (nursing) care are growing in importance. This exploratory study, a strand of the *Rhythm for Life* project at the Royal College of Music, London, investigated the role that music could play as such a preventive strategy. The study used a quasi-experimental mixed-methods design with 72 participants aged 50 years and older, and an age-matched control group. Participants were grouped into either ex-



perimental (learning an instrument) or control (activity as usual) groups, and assessed at baseline level and after ten weeks. Qualitative data were obtained through observation, as well as an individual case study, and quantitative data through established self-report assessment questionnaires. Results presented a positive impact of learning an instrument and making music on older adult learners, especially an improvement in mental wellbeing and hand flexibility.

### **Flexibility in the use of shared and individual performance cues in duo performance**

*Tânia Lisboa, Roger Chaffin, Alexander Demos, and Cristina Gerling*

We compared the *performance cues* (PCs), i.e. mental landmarks, reported by members of an established cello/piano duo in two concert performances of the F. Bridge *Cello Sonata*. We examined *overlap* between reports for *individual* and *shared* PCs and for both (*all* PCs). For the cellist, overlap across performances was higher for all and individual (35%) than for shared PCs (19%). For the pianist, overlap was highest for all (23%), lower for shared (15%), and lowest for individual PCs (6%). Both musicians prepared more PCs during practice than they actually used in any one performance, using them flexibly to achieve stability in performance. Differences between the musicians may have reflected differences in their musical roles or temperaments.

### **New limits of musical art expression: Serbian concept of interaction in the classical art form**

*Mirjana Matović and Vanjuška Peković*

The communication between the performer and the audience is very rare on the Serbian classical music scene. This is why the steps in this direction, taken by a small number of artists, are very important. An interactive concept in this form means that the listener has to come rested to the concert in order to be able to participate. It is possible to achieve direct contact successfully with the audience on several communication levels by applying multiple instruments and theatrical elements. This results in the converging of elitist and populist aspects in the classical musical expression, thus expanding the limits of perception of artistic reality. The classical concert is facing a shrinking audience in the contemporary Serbian society. This results in the need of introducing elements from the global classical music scene in order to attract the audience back to the concert halls and acquaint the contemporary Serbian audience with the classical forms. The appearance of modern forms of performance on the classical music scene in Serbia marked the beginning of the twenty-first century. The newly acquired openness of this genre towards a variety of other arts led to a multidisciplinary approach to well-known musical forms. This resulted in direct contact between performers and listeners, on the audio as well as visual level.

### **The relation between the key and performance motion on the keyboard instrument**

*Yuki Mito, Hiroshi Kawakami, Masanobu Miura, Yunitaka Shinoda, and Mieko Marumo*

We examined the performance motion of a professional pianist conveying Juslin's five emotions and an emotionless condition using a motion capture system. C major was used as the key for the performance task. We examined each center of gravity using the recorded trace. As a result, there was a difference in the emotional expression of the performance in the head and upper arm. In addition, movement conveying positive emotion was described as circular from the rear viewpoint.

### **Embodying and learning individual creative methods: Sharing ideas and images for the interdisciplinary collaboration art project**

*Tomoko Mukai, Hiroshi Kawakami, Yasuhiro Kumagai, Julian Manning, Satomi Tanaka, Kunitoshi Okuno, and Hiroshi Aikawa*

This ongoing art project is led by experts from a wide range of different academic disciplines who are normally teaching in separate departments of the College of Art, Nihon University. The project aims to realize artwork through deeper, substantial interdisciplinary collaboration. This year, as the first step, it is focusing on some forms of experimental performance, which are co-produced by external professional performers, such as dancers and actors. For this purpose the project emphasizes experimental workshops during the production until the final presentation. The workshops are based on unique and creative methods derived from the subtle perception and experiences in the creative processes of individual experts. All academic experts provide workshops with the performers for the other members. These workshops enable the various contributors to share and learn from each other's experience to find deeper ideas and contribute toward creative processes intensively and productively. It is important to record and describe processes, making use of various types of metadata: words, sounds, sketches, pictures, and video, so that participants can verify their own creative processes and methods objectively.

### **Comprovisession: Improvisational real-time composing environment for multimedia session performance**

*Yoichi Nagashima*

In this paper, a new idea called "Comprovisession" for multimedia performances with some improvisational performers is explored. An investigation of the problems of past systems is carried out with the aim of supporting improvisations not only for performances but also for compositions reflected on the structure of music. In addition to this, the improvisational performers will be able to grasp the interactions visually as well as by listening. As a concrete example, the special project "Jami-Girls' Band," and the system of this performance will be introduced.

### **Exercise physiology of piano playing**

*Hidehiro Nakahara, Shinichi Furuya, Satoshi Obata, and Hiroshi Kinoshita*

Eleven pianists performed four octave, bilateral scales at each of five tempi (60, 80, 100, 120, and 138 bpm) at three sound-pressure levels (83.0, 87.0, and 90.0 dB). They also played a self-selected favorite classical piece of a tempo at around 120 bpm with full emotions. Oxygen uptake ( $\text{VO}_2$ ), carbon dioxide production ( $\text{VCO}_2$ ), energy expenditure (EE), minute ventilation (VE), tidal volume (VT), respiration rate (RR), and heart rate (HR) were evaluated using gas analyzing system. Mean HR,  $\text{VO}_2$ , and EE increased curvilinearly with tempo. At the fastest tempo at the strong dynamics, HR was elevated to 103 bpm, and  $\text{VO}_2$  was 360 ml/min with EE of 2.6 kcal/min. VE was also increased with tempo, which was accounted for by RR (64%) and very little by VT (8%). Mean HR when playing a favorite musical piece was 100.8 bpm, which was significantly higher than 90.6 bpm during scales played at a similar tempo.  $\text{VO}_2$  did not differ between these conditions. Physiological measures examined indicated that piano playing was a relatively light physical work, and RR plays an important role in ventilation. Cognitive load of emotional playing of their favorite music modulates autonomic nerve activity independent of energy cost of performance.

### **An electromyographic study of the left hand in violin playing**

*Satoshi Obata, Hidehiro Nakahara, Takeshi Hirano, Chie Ohsawa, Ryuhei Okuno, Taro Ito, and Hiroshi Kinoshita*

Surface electromyogram was obtained from the left flexor digitorum superficialis (FDS), extensor digitorum communis (EDC), fourth dorsal interosseous (DI4), opponens pollicis (OP), biceps brachii (BB), triceps brachii, and brachialis anticus muscles to investigate muscle activity during single and vibrato tone production on the violin. Six trained violinists performed successive A4 and D5 tone production using the ring finger at varied tempi and dynamics with and without vibrato. String clamping force and 3D kinematics of the finger were also recorded. The mean activity of DI4, OP, EDC, and FDS increased with tempo, but not with dynamics. The finger's upward and downward velocity was also increased with tempo while string clamping force was decreased. Subjective evaluation of effort and strenuousness increased with tempo. The findings suggest that the speed of finger movement is related to the discomfort of the arm and hand in violin playing, and less to the clamping force. There was a reciprocal activity in the sets of flexor and extensor muscles during vibrato. The findings suggest that the synergistic use of wrist flexion and extension play an important role in both string clamping and shaking force productions during vibrato.

### **Music and speech performance: Music characteristics of Serbian accents**

*Milena Petrovic*

There is a close connection between speech and music, i.e. the spoken accent and musical features of speech. The Serbian system of accentuation is extremely melodious. The main musical characteristics are: duration (two shorts and two longs), intonation (two upwards and two downwards), tempo (three shorts and one fast), and intensity (of minor importance). There are four main accents in the Serbian language including short-downward, short-upward, long-downward, and long-upward. In polysyllabic Serbian words, each syllable can be stressed except for the last one. Downward accents appear on the first syllable and in monosyllables, while only upward accents appear freely on each syllable, except on the last one. A great number of scientists and theoreticians have researched music characteristics of Serbian accents trying to realize their music transpositions: downward intervals in downward accents are larger than upward intervals in upward accents (both long and short); the major interval for short downward accents being approximately a major sixth, while the major interval for long downward accents is approximately the interval of a seventh. The size of interval in speech depends on the meaning of the word as well as on the emotional level of the interpretation.

### **Infrared thermography as diagnostic tool for physiotherapeutic taping support of musicians**

*Marija Podnar and Matthias A. Bertsch*

Players of asymmetrical instruments, like the violin or flute, often suffer from health problems through the required unnatural body positions. The risk for overuse symptoms partly depends on the type of instrument but is also very individual. That is why all kinds of ergonomic support or therapeutic help have to be adjusted and customized. To detect individual critical areas, this pilot study presents non-invasive infrared thermography imaging of the bodies of eight different players. The assumption is that hot regions (i.e. more active and more vascularized areas) correspond with regions of higher risk for overuse and pain. The presented results show temperature change after 90 minutes of practicing the instruments. The measurements at 21 points could reveal many asymmetric and individual differences before and after playing. In addition, it was demonstrated that thermocam measurements with applied K-Tapes are also possible, since the material approximates the temperature of the skin below. The objective of a follow up study will be to determine whether the use of K-Taping—often used by sports therapists—could support pain relief for musicians with muscular problems or could be used as individual prevention opportunity.

### **An exploration of the pianist's multiple roles within the duo chamber ensemble**

*Evgenia Roussou*

The current research explores the multiple roles of the pianist within the traditional Western art solo-accompaniment duo chamber ensemble. Based on a survey of existing literature, including historical, pedagogical, and empirical texts on chamber ensemble practice (specifically piano accompaniment), five roles are identified for the pianist in a solo-accompaniment duo ensemble: (1) co-performer, (2) soloist, (3) coach, (4) accompanist, and (5) collaborator. An overview of these roles is provided through consideration of their functional and socio-emotional qualities. The importance of understanding the multiple roles of the pianist in chamber ensemble practice is revealed along with implications for further research.

### **Classification and visualization of dance movements of Nihon Buyo using motion capture system**

*Yukitaka Shinoda, Yusuke Mizutani, Yuki Mito, Reishi Watanuma, Toru Ozawa, and Mieko Marumo*

Using an optical motion capture system to examine the center of gravity of dance movements for dancers in various age groups belonging to five major schools of Nihon Buyo, we constructed a system for visualizing a dancer's center of gravity and studied the classification of dance movements using feature quantities describing center-of-gravity motion. In this paper, we report on the construction of a visualization system that can display the dance movement and center-of-gravity motion of dancers from multiple schools simultaneously. We use this system to uncover the feature quantities of a dancer's center-of-gravity motion and to classify the schools of Nihon Buyo accordingly.

### **Performing Together? A case study of physiological stress between soloist and audience**

*José Fernandes Oliveira e Silva, Maria João Soares, Luís Souto Miranda, Anabela Pereira, and Nancy Lee Harper*

Several studies looked at psychological or emotional interaction between musicians and audience while performing. Little scholarly information, however, is available regarding the physiological communication between musicians and audience. By using non-invasive immunoassay salivary cortisol testing, this study examined the physiological stress levels in a solo oboe performer and four audience members. The study was realized within the context of three live performances in two different venues and two different musical contexts in order to determine possible correlations between performer and public. Recitals 1 and 3 had the same solo program performed at the same venue of a university at the same hour of the day, while Recital 2, consisting of contemporary chamber music, was performed at a prestigious concert hall in a major European city. The results of the this pilot study could demonstrate that exaggerated physiological stress of the performer was not communicated to the audience, but had rather the opposite relaxing effect on the audience, thus attesting to the professionalism of the musician in controlling the stress while maintaining a high level of performance.

### **A comparison of practice on a MIDI wind controller to practice on single-reed instruments**

*Laura A. Stambaugh*

In the study of piano performance, the use of MIDI keyboards and computer software has improved measurement efficiency and accuracy of data analysis. MIDI wind controllers have existed for over 20 years, but their feasibility as a tool in wind instrument research has received little attention. The purpose of this investigation was to determine the validity and practicality of using a MIDI wind controller in instrumental performance research. Specifically, this

study examined performances of the same passages, played by the same performers on a wind controller and played on a saxophone or clarinet, for pitch and rhythmic accuracy. The final phase of the study replicated procedures from previous research comparing the effectiveness of practice strategies on woodwind instruments.

### **Trumpet and marimba: Combining sounds in Brazilian music**

*Eliana Gugliemetti Sulpicio and Carlos Sulpicio*

The main purpose of this article is to provide information regarding Brazilian music for trumpet and marimba duo. *In Tempori Duo*, formed by the authors of this paper, started performing chamber music for trumpet and percussion in Brazil from 1990 onwards. As a result, many Brazilian composers wrote for this duo. About twelve pieces have been composed for *In Tempori Duo*, mostly for trumpet and marimba.

### **Effects of physical training on the stability of operatic singing: Acoustical analyses and physical measurements after isometrics**

*Minoru Tsuzaki, Hidetoshi Ue, Tadamichi Orie, and Taemi Kohama*

To investigate the effectiveness of a new type of training for singing, i.e. isometric training for the muscles to maintain the steady posture of the upper half of the body, nine undergraduates of Kyoto City University of Arts, majoring in vocal music, provided samples of singing before and after isometric training spanning nine months. The isometric training improved the physical achievement of each participant. The total durations of maintaining body posture became significantly longer than at the very beginning of the training. Three undergraduates, majoring in vocal music, provided samples of singing as a control group. Acoustic analyses revealed that the physically trained participants could modulate the fundamental frequency more prominently than the control group. On the other hand, the fluctuations in intensities and spectral patterns were suppressed more effectively in the training group than the untrained group. These results indicated that the isometric training affected the way of controlling the singing or phonation. The changes caused by the physical training can be assumed to improve the stability of singing voices.

### **Simulating and stimulating performance: Designing and validating simulated music performance settings**

*Aaron Williamon, Lisa Aufegger, and Hubert Eiholzer*

Musicians typically rehearse far away from their audiences and in practice rooms that differ significantly from the concert venues in which they aspire to perform. Due to high costs and the inaccessibility of such venues, much current international music training lacks repeated exposure to realistic performance situations, with students learning all too late (or not at all) how to manage the challenges of performing and the demands of their audiences. Simulation has been shown to be an effective tool for training students in the fields of medicine, clinical therapy, and sport, offering practitioners access to real-life performance scenarios but with much lower risk of negative outcomes and evaluation. Only few attempts have been made to apply simulation training to music. The aim of this project was to design simulated performance environments in which the conditions of “real” performance could be recreated as authentically as possible. Advanced violin students (N=12) were recruited to perform in two distinct simulations: (1) a solo recital with 24 virtual audience members and (2) an audition situation with three “expert” virtual judges. Each simulation contained back-stage and on-stage areas (complete with CCTV footage of the audience/audition panel, spot-lights, and stage curtains), life-sized virtual audiences who were interactive (controlled from back-stage), and pre- and post-performance protocols designed to match those found at leading international performance venues (e.g. entrance to a “green room” for warm-up, stage calls at regular intervals, and procedures for entering, bowing, and exiting the stage). Participants were then asked to complete a questionnaire on their experiences of using the simulations and take part in a semi-structured interview. The results show that both simulated environments offered sufficiently realistic experience of performance contexts to enable musicians to practice their performing. The musicians reported numerous training and educational applications of the technology, from preparing for important recitals and auditions to delivering higher quality performances.

### **Preferences in practicing chamber music**

*Leonardo Loureiro Winter and Fernando Gualda*

This research aimed to develop and apply an online, qualitative-quantitative questionnaire to 66 music students in their practice of chamber music. The participants were enrolled as students in the Music Department (UFRGS) with different levels of musical instruction, years of musical practice, and instruments. The questionnaire aimed to identify periodicity of rehearsals, criteria for ensemble partner selection, motivation for performing in an ensemble, lead-

ership establishment, and rehearsal techniques used by students in their activities. Results showed a preference for personal choices over partners' choices, with flexibility in rehearsals when necessary. The main advantage of practicing chamber music, according to the participants, was the opportunity to exchange knowledge and experiences and to develop concentration, a sense of responsibility, and respect for one another. Reported challenges included the construction of similar interpretations and understandings of the music, overcoming self-centrism and individual personalities, differences in level of study and experience, achieving rhythmic synchronicity, adapting to the kind of repertoire and style of playing, and forming a schedule of rehearsals. Rhythmic inaccuracies and structural mismatches were reported as the main reasons to interrupt a rehearsal.

## Thematic Sessions

### ENSEMBLE SYNCHRONIZATION

#### **Patterns of entrainment: Being out of sync, in sync, and in between**

*Tommi Himberg and Neta Spiro*

In order to investigate a previously uncharted range of dyadic entrainment behaviors, we conducted a dyadic tapping study on resisting entrainment. Participants were asked to maintain their own tempo while interacting with their tapping partner. Different patterns of entrainment emerged, but trials were often either highly entrained or not at all. As expected, initial tempo difference between the participants was the main factor determining whether a trial was entrained or not, but a clear threshold was not found. Musical training, but not individual rhythmic skill or personality traits, had an effect. Surprisingly, participants with musical training were more likely to entrain even over a large tempo difference, perhaps owing to their training in playing together and learned aesthetic preferences.

#### **Multidimensional analysis of interdependence in a string quartet**

*Panos Papiotis, Marco Marchini, and Esteban Maestre*

In a musical ensemble such as a string quartet, the performers can influence each other's actions in several aspects of the performance simultaneously. Based on a set of recorded string quartet exercises, we carried out a quantitative analysis of ensemble interdependence in four distinct dimensions of the performance: dynamics, intonation, tempo, and timbre. We investigated the fluctuations of interdependence across these four dimensions, and in relation to the exercise being performed. Our findings suggest that, although certain differences can be observed between the four dimensions, the most influential factor on ensemble interdependence is the musical task, shaped by the underlying score.

#### **Temporal coordination in string quartet performance**

*Renee Timmers, Satoshi Endo, and Alan M. Wing*

Temporal coordination between members of a string quartet performing an excerpt of a Haydn string quartet was characterized in terms of patterns of dependence between player note onset times estimated from acoustic data, and compared to self-reported patterns of dependence between players. Audio onsets revealed temporal dependencies indicative of a leading-following relationship between the first and second violin and a relationship of mutual adaptation between the first violin and both the viola and cello. This relationship of mutual adaptation was not reflected in the self-reported dependencies, which predominantly ascribed a leadership role to the first violin.

### ANALYZING MUSICAL MOVEMENT

#### **Is emotional drumming realized in both sound and movement?**

*Masanobu Miura, Erwin Schoonderwaldt, and Eckart Altenmüller*

In order to investigate the contribution of body movement and sound on emotion expression, snare drum performances of a simple etude with posing of six basic emotions by three percussion students were captured using motion capture. Body parameters characterizing emotional movements were calculated from motion data and were fed into a machine learning system so as to rate which emotion was expressed during performance. Analysis was done using normalized (stretched) motion data in order to standardize the length of time for all recorded patterns. The contribution of impact and contact duration on emotional expression was obtained from the velocities of the tips of the

drumsticks, of which the position was calculated from reference markers put on the middle of the drumsticks. Extracted parameters were then compressed by principle component analysis. The number of obtained parameters was 45 for body motion and 3 for sound. A naive Bayesian estimation with 10-fold cross validation was conducted. Here, the recognition rates were 77.8% (body), 85.6% (sound), and 88.9% (body and sound), which implies that both body movements and sound quality are effective for expressing emotion during snare drum performance.

### **Characterizing violin glides in cadential versus noncadential sequences in solo Bach**

*Jiayi Liu*

This study examines the articulatory changes (glides) between the leading tone and tonic note of cadential versus noncadential semitone sequences in solo violin performance. It was predicted that, though these glides would have similar slopes, they would differ in duration and semitone intonation and that these latter properties could characterize the expression of cadential finality and the structural insignificance of noncadential sequences. Cadential ( $n=46$ ) and noncadential ( $n=58$ ) targets from 17 recordings by 13 professional violinists were analysed using narrow-band spectrograms. Glide durations comprised 16% of the overall duration of semitone sequence irrespective of structure function. However, cadential glides comprised 28% of the duration of the leading tone compared with 11% for noncadential glides. As predicted, the leading note tended to be sharp in both contexts, but the mean cadential interval was nonsignificantly larger by 18 cents, mainly because the tonic tended to be tuned more accurately in cadential sequences. Finally, the glide direction was linear and followed the natural vibrato trajectory in both contexts as expected. These data confirm that articulatory modifications play a prominent role in the performance of intended musical structure and suggest that such distinctions will influence structural expectancies.

### **The use of fine-wire EMG to investigate the kinematics of cello bowing: The results of a pilot study**

*Dale Rickert, Mark Halaki, Karen Ginn, Margaret Barrett, and Bronwen Ackermann*

The mechanics of music making is important both in preventing injuries and in guiding how music is performed and taught. Electromyography (EMG) measures muscle activity patterns and has been shown to be a useful resource in understanding the loads involved in instrumental playing; however, only a small number of projects have been undertaken, and little is understood on the muscle activity used during string bowing. This project used a combination of fine-wire and surface EMG to evaluate the muscular load placed on the shoulder of a professional orchestral cellist playing a set of bowing exercises. The results indicated that EMG was useful in measuring shoulder load and that fine-wire electrodes did not interfere with normal playing technique. Different bowing techniques produced statistically different levels of muscle contractions, with the supraspinatus muscle in particular maintaining significantly higher levels of contraction during all bowing patterns.

## **PERCEPTION OF PITCH**

### **Intervals as distances, not ratios: Evidence from tuning and intonation**

*Richard Parncutt and Graham Hair*

Many music theorists and psychologists assume a direct link between musical intervals and number ratios. But Pythagorean ratios ( $M3=61:84$ ) involve implausibly large numbers, and just-tuned music ( $M3=4:5$ ) only works if scale steps shift from one sonority to the next. We know of no empirical evidence that the brain perceives musical intervals as frequency ratios. Modern empirical studies show that performance intonation depends on octave stretch, the solo-accompaniment relationship, emotion, temporal context, tempo, and vibrato. Just intonation is occasionally approached in the special case of slow tempo and no vibrato, but the reason is to minimize roughness and beating—not to approach ratios. Theoretically, intonation is related to consonance and dissonance, which depends on roughness, harmonicity, familiarity, and local/global context. By composing and performing music in 19-tone equal temperament (19 ET), the second author is investigating how long it takes singers to learn to divide a P4 (505 cents) into eight roughly equal steps of 63 cents, or an M2 (189 cents) into three; and whether the resultant intonation is closer to 19 ET or 12 ET. Given that the average size of an interval depends on both acoustics (nature) and culture (nurture), it may be possible to establish a sustainable 19 ET performance community.

### **Does practice affect timbre-induced pitch shift?**

*Allan Vurma*

Fifteen pianists and sixteen string players had to decide whether the pitch of two tones heard in successive tone-pairs was the same or different. The level of the fundamental components of the spectrum of the sounds was either in-

creased or decreased in order to acquire stimuli with bright and with dull timbral variants. The fundamental frequency of the tones was also manipulated. The  $F_0$ -s of the tones of the pair could fall either into a pitch region around  $D\#_3$ ,  $D_4$ , or  $C\#_5$ . The comparable stimuli could follow each other either immediately or after a 3.5 s interval of silence. The responses of the participants in different test conditions were analyzed and discussed in the framework of Signal Detection Theory. All factors of the experiment had statistically significant influences on the sensitivity ( $d'$ ) of the participants and on the bias ( $c$ ) of their replies. On the basis of the acquired results, we may conclude that although the timbre induced pitch shift is a universal phenomenon, the level of its manifestation may depend on the practice of the musician and on the type of musical task.

## PERFORMANCE HEALTH AND WELLBEING I

### **Vibrato retraining of a cellist suffering from musician's dystonia: A collaborative approach**

*Rae de Lisle, Dale B. Speedy, and John M. D. Thompson*

Dystonia affects musicians in a variety of ways; in pianists fingers can curl or extend uncontrollably, fingers can curl on a violinist's fingerboard, wind players can experience difficulties with forked fingering, and the cramping of lips in brass players can affect the embouchure. Less common is the effect of musician's dystonia on the vibrato of string players. This case study describes a professional cellist whose difficulty in controlling the speed and amplitude of vibrato was affecting her sound and threatening her orchestral career. A systematic retraining protocol based on principles of instrumental technique and optimum biomechanics was introduced and her condition improved significantly so that she was able to continue playing professionally.

### **Pointing to performance ability: Examining hypermobility and proprioception in musicians**

*Terry Clark, Patricia Holmes, Gemma Feeley, and Emma Redding*

People have varying levels of hypermobility and proprioception that are held to be interrelated. This study sought to investigate hypermobility and proprioception in vocational-level musicians, comparing different instrument groups and examining variables that might account for these differences. Demographic information, handedness, musical background and training, injury history, joint hypermobility, and proprioception were collected from 28 music performance students. The participants had a mean hypermobility score of 2.14 ( $SD=2.45$ ) with the men exhibiting less hypermobility than the women. While not significant, all instrument groups demonstrated clear differences in proprioception between the left and right hands. For the strings, harps, and pianists, these findings appear indicative of the mechanics of sound production. No significant findings emerged when examining the impact of hypermobility, training, or previous injury on proprioception. The findings support the use of the Leeds Hand Proprioceptometer as a valid means of assessing musicians' finger proprioception and suggest that, in highly trained musicians, the instrument played does influence proprioception.

### **Performance measures in pianists: A method of enhancing communication with clinicians**

*Hara Trouli, Howard Bird, and Kathleen Riley*

Pianists with clinical symptoms in the upper limbs can be a challenge for the medical practitioner. Meticulous history taking and clinical examination along with relevant investigations are essential in the diagnostic process. It is important, however, to also assess the technical elements of piano playing and correlate these to the clinical features. We used digital recording (MIDI), video filming, and surface electromyography to look at the biomechanical elements of playing. The system that provided this multimodal assessment was ProformaVision®. We recruited 10 pianists with various clinical presentations and assessed them with ProformaVision® while they performed basic technical tasks on the keyboard. We interpreted the visual recordings and graphs using measures for each modality and expressed these symbolically and numerically on a chart that enabled us to see the pianist's technical elements at a glance. Our participants were not enough to give us statistical results and this research remains in progress. These preliminary charts, however, give us the opportunity to envisage creating a method of communication between musician and clinician and promise to become a useful tool in the monitoring of rehabilitation and recovery from injury.

## TECHNIQUES FOR MEMORIZING PERFORMANCE

### **Retrieval cues as a teaching tool in one-to-one instrumental lessons: A pilot study**

*Clarissa Foletto, Sara Carvalho, and Daniela Coimbra*

In cognitive psychology, retrieval cues are considered stimuli that assist information recovery in long-term memory. In educational contexts, they have been investigated as a teaching and learning tool as a means to promote mean-

ingful learning. However, discussion on the use of these specific cues as a tool in instrumental teaching literature has been scarce. Therefore, it is not yet possible to understand the potential impact of this exploration on instrumental lessons. The aim of the present study was to both verify and identify the use of retrieval cues by the teacher in one-to-one violin lessons. This empirical pilot study consisted of video observation of twelve one-to-one violin lessons. The participants (N=6; female) were two teachers (aged 28 and 32 years) and four violin students (aged between 11 and 13 years). A set of retrieval cues was identified using qualitative analysis. A quantitative approach has allowed us to verify that most of the retrieval cues were used during verbal communication; specifically, when the teachers focused on aspects related to technical and/or motor skills. The results of this study highlight the importance and the need to organize a way to explore the use of retrieval cues as a teaching tool.

### **Recording thoughts as an aid to memorization: A case study**

*Tania Lisboa, Roger Chaffin, and Alexander Demos*

We describe how an 18 year-old piano student (Grade 7, ABRSM) learned to memorize. The student, who had previously ignored suggestions that she play from memory, decided to learn to memorize, selecting Schumann's "Der Dichter Spricht" for this purpose. Rather than explicitly teaching the student to memorize, the teacher taught her to record her thoughts by marking them on copies of the score, a technique inspired by studies of how experienced soloists memorize. Over a seven-week period, the student recorded her thoughts while practicing (5 times) and while performing from memory for the teacher (3 times) and video-recorded three weeks of practice and three performances. Her thoughts were relatively stable over time and occurred at locations where playing started during practice. The student was able to perform from memory after four weeks and to reconstruct the piece from memory after a four-month break. The speed and durability of her memorization inspired the student to perform in public and use the same technique for new pieces. Recording thoughts appeared to aid memorization.

### **Mapping the strategies employed by piano students during memorized performance**

*Cristina Capparelli Gerling and Regina Antunes Teixeira dos Santos*

The present study investigated the strategies employed by undergraduate piano students (N=9) during memorized performances under two conditions: (1) the spontaneous use of the player's own resources and (2) after Chaffin *et al.*'s performance cues (PC) protocol. Data collection proceeded in two phases: the recording of the performance of repertoire the student studied during the investigated academic semester and a semi-structured interview. The students' own resources for memorized performance could be classified into seven categories; the most commonly used strategies were structural and expressive. Under the second study condition, the students were capable of managing the PC protocol. In the investigated sample, the employed PCs were found to be related to the style of the piece, which may indicate that explicit memory (content-addressable cues) seems to be associated with the deliberate expression of a given piece's stylistic structure. Furthermore, tempo seems to modulate the number of PCs necessary to guarantee a successful memorized performance, i.e. the faster the tempo was, the fewer PCs were employed.

## **SYMPOSIUM:**

### **TIMING AND DYNAMICS IN MANDE ENSEMBLE DRUMMING: METRIC WELL-FORMEDNESS AND PERCEPTION-ACTION COUPLING**

#### **Mande ensemble drumming: An introduction to Ngòn**

*Rainer Polak and Justin London*

This paper introduces an ethnically and regionally specific style of dance-drumming from central Mali. Subject matters include the performance context, instruments, and the musical roles of ensemble members: the central metrical accompaniment, the repertoire-determinative "hook," and the improvising and regulative lead drum. With an example of a particular piece of repertoire (*Ngòn*), we will detail the basic drumming patterns used in each part. Finally, we will discuss the metrical implications of the ensemble's polyrhythm.

#### **Microtiming in Ngòn: Categorical production and perception of a non-isochronous meter**

*Justin London and Rainer Polak*

Timings data from six performances of *Ngòn Fariman*, a Mande ensemble drumming piece characterized by a pattern of long-short-short beat subdivisions, are analyzed, providing evidence of discrete categories of beat subdivision (long versus short) as well as evidence of expressive variations within each category. The effects of the large-scale structural acceleration, characteristic of *Ngòn*, and the presence of performance-specific microtiming patterns indic-



ative of distinctive “swing feels” are also assessed. The implications of *Ngòn*’s rhythms for the categorical perception of duration, beat induction, and theories of musical rhythm and meter are then discussed.

## **PERFORMANCE HEALTH AND WELLBEING II**

### **Interactive performance: Toward the use of vibrotactile technology by musicians with hearing impairments**

*Jane Ginsborg, Carl Hopkins, Robert Fulford, Saul Mate-Cid, and Gary Seiffert*

Many people with hearing impairments enjoy playing music, but we know little about how they make use of vibrotactile information from their instruments and how this might be extended to the context of interactive performance. In semi-structured interviews, musicians who have hearing impairments and play in ensembles from duos to orchestras revealed that they meet challenges such as staying in time and in tune with fellow performers not only by rigorous preparation but also through awareness of vibrotactile feedback. An observational study of flute-piano duo rehearsals involving participants with and without hearing impairments has highlighted the importance of gesture in verbal as well as non-verbal communication during rehearsal. Experiments using vibrotactile technology showed no difference in the sensitivity to vibrotactile information of those with and without hearing impairments. They also indicate that it is possible to discriminate higher from lower pitches when presented as vibration and that this ability can be improved with training. However, to develop vibrotactile technology to help facilitate and enhance interactive music-making for musicians with hearing impairments, we still need to know more about potential constraints, including pitch, dynamic range, sensitivity of the skin on different parts of the body, and the ability to learn pitch-vibration associations.

### **The effects of hearing impairment on interactive performance: Two observational experiments**

*Robert Fulford and Jane Ginsborg*

Anecdotal evidence suggests that a hearing impairment increases reliance on visual cues in music performance. To investigate further, two studies were designed to explore how (1) auditory feedback and (2) natural deafness affect interactive rehearsal and performance. Study 1 aimed to establish a link between reduced auditory feedback and increased visual attending as evidenced by looking and movement behavior between violinists in duos. Study 2 aimed to explore verbal and non-verbal communication processes in rehearsal and performance as evidenced by looking behavior, rehearsal talk, and speech-gestures used by performers in flute-piano duos. The attenuation of auditory information using earplugs had no effect on violinists’ movement or looking behavior. The possibility of eye contact, however, produced increases in both movement and looking behavior. In Study 2, profoundly deaf musicians spent significantly more rehearsal time talking, looking towards their co-performer, and gestured more during speech. Hearing musicians adapted their behaviors within rehearsals for their co-performers’ benefit by looking and gesturing more. In conclusion, only profound, congenital deafness significantly affected rehearsal behaviors; the adjustments made by normally hearing musicians suggest that compensatory strategies can be adopted quickly. Small changes to the level or quality of auditory feedback did not hamper group music performance.

### **How to identify and manage stress VPI: Recommendations for wind instrumental teachers and students**

*Alison Evans, Tim Driscoll, and Bronwen Ackermann*

Stress velopharyngeal insufficiency (stress VPI) is frustrating and potentially career threatening to a wind instrumentalist. The prevalence among student musicians is as high as 39%. Most students seek advice primarily from their instrumental teacher, who is responsible for their technique development, and few students seek professional medical advice. Despite the high prevalence rate, anecdotal evidence suggests that many students and teachers are unaware of the symptoms of stress VPI and factors that may lead to this condition. A lack of knowledge may lead to insufficient advice from most woodwind and brass teachers, and many students may then experience prolonged recovery times due to their failure to respond to early warning signs. This paper aims to outline the symptoms and causes of stress VPI and attempts to recommend commonly used management methods.

## EVALUATING MUSIC PERFORMANCE

### Thoughts in concert: A multi-method approach to investigate the effect of performers' focus of attention

*Anemone G. W. Van Zijl and Geoff Luck*

Does it matter what a performer feels or thinks about while performing? To investigate the effect of performers' focus of attention on their performances we asked eight violinists to play the same musical 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. Following a sadness-inducing mood induction task, the third instruction was to play while focusing on felt emotions. High quality audio and three-dimensional motion-capture recordings were made of all performances. Subsequently, thirty individuals rated how much they liked each performance, how skilled they thought each performer was, and to what extent each performance was expressive of sadness. Computational analysis of the audio and motion-capture recordings revealed differences between performance conditions. Statistical analysis of the perception data revealed that individuals 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 were rated as being most expressive of sadness. The findings suggest that a performer's focus of attention has an effect on the audio features, movement features, and perception of their performances.

### Between producers and consumers: Critics' role in guiding listeners' choices

*Elena Alessandri, Hubert Eiholzer, and Aaron Williamon*

This study investigated how professional critics' judgments of recorded performances relate to other listeners' preferences. Music students ( $n=10$ ) and music professionals ( $n=7$ ) were asked to rate their liking of five interpretations of the opening of Beethoven's Piano Sonata Op. 111. Listeners' likings were compared with judgments given in reviews published in the *Gramophone*. Correlation between critics' judgments and music professionals' preferences was moderate, while no correlation was found between critics' evaluation and music students' likings. The results suggest that preferences for given interpretations of a piece vary between listeners and may be influenced by the listeners' prior experience of detailed listening and study of repertoire and its renditions.

### Pianists' perceptions on performance criteria: Results of a factor analysis

*Yuki Morijiri*

This paper focuses on constructed elements of piano performance from the viewpoints of the performers themselves. Performers were asked to classify fourteen key features of piano performance as either more technical or interpretative in nature, and also to indicate the relative importance of each feature in their own piano performance. Sixty-four professional standard pianists participated. The data were analyzed by undertaking an exploratory factor analysis and, as a result, five factors were extracted: representative of overall quality, expressive variation, technical precision, rhythmic integrity, and stylistic appropriateness. In terms of relative prioritization of creating a piano performance, some elements were strongly correlated, such as dynamics and touch. It could be said that piano performance criteria embraced hierarchical dimensions in performance that were evidenced across the participant group.

## THE SCIENCE OF DANCE III

### Pain, pleasure, and performance: Embodied identity of young dancers and musicians

*Angela Pickard*

This paper examines aspects of the social worlds of dance and music, embodiment, and identity of young ballet dancers and young classical musicians. Pierre Bourdieu's critique of the perpetuating social order and theoretical concepts of *habitus* and capital are applied as a way of understanding the social worlds, as well as to examine the performers' habitus. This work is part of a larger, longitudinal study of young performers that focuses on the experiences and identities of 12 young performers: 6 dancers (3 boys, 3 girls) and 6 musicians (3 boys, 3 girls) during their process of "becoming" a performer as they engage in non-residential specialist schooling. Mixed methods are used in the larger study. This paper reports qualitative findings from individual, semi-structured interviews. It is suggested that the performers' habitus is produced through dominant beliefs about the body where it is assumed that the young performers will accept emotional and physical pain, develop resilience, and engage with the body as a project. Alongside the pain there are also memorable felt bodily pleasures that have physical and psychological significance. Findings reveal relationships between the performer, the social worlds of dance and music, and identity.

**Controlling balance: Static and dynamic balance within dance populations**

*Frances A. Clarke, Matt Wyon, and Sally Percival*

All dance genres demand a high level of control in static and dynamic balance, but there is little published research on balance in the dance field. Previous research on dancers' balance abilities has relied on tests such as the Star Excursion Balance Test (SEBT), Y Balance Test, a modified SEBT (mSEBT), a modified Romberg test, and the Airplane test. This study has assessed the validity of existing balance tests for dancers with particular reference to the relevance of static versus dynamic balance. Eighty-five female dance undergraduates were recruited for balance tests using the Star Excursion Balance Test (SEBT), the Y Balance Test, the modified Romberg test, the Airplane test, the BioSway Balance System (Biodex, USA), and the dance-specific pirouette test. No correlation was found between the types of balance tests, and the variables helping to determine one test did not necessarily help to determine the other tests. Previously, the balance and stability tests have been employed during screening of dancers with low to moderate success in predicting injury. The present study challenges the validity of these tests in relation to dance relevant skills and points toward the need to develop dance-specific tests.



Abstracts  
Saturday, 31 August 2013

# Thematic Sessions

## **SYMPOSIUM: THE COLLABORATIVE SPACE: DIRECTING PERFORMERS' AWARENESS VIA CREATIVE ROLE-PLAY**

### **The studio experience: Control and collaboration**

*Amy Blier-Carruthers*

Classical musicians have traditionally not been trained for the recording studio to the same extent as for the concert platform. This paper presents how we at the Royal College of Music aim to provide students with a conceptual understanding and practical experience of recording.

### **The actor at the piano**

*Paul Barker and Alban Coombs*

Frederic Rzewski's *De Profundis* is a score which implies skills far beyond those normally associated with pianism. We have approached the realization and performance of this work through a hybrid methodology synthesizing theatrical and musical disciplines. Our objective is to allow the essence of the performance to co-habit Wilde's and Rzewski's voices, alongside those of Coomb's and Barker's. From the outputs of rehearsals, workshops, and accompanying discussions, we demonstrate the ways in which acting is implicit for all pianists, as well as identify methodologies and techniques that might be offered as a tool for training in stage presence for conservatoire musicians. The pianist, the most proverbially immovable of all instrumentalists, is in fact never still, constantly shifting or moving between many persona or characters, seen and unseen, all together. From the results we hope to demonstrate that the pianist, as an actor at the piano, assumes different roles, both implicitly and explicitly, regardless of the score.

### **Listener enactments in song without a singer**

*Amanda Glauert and Maria Setiadi*

This paper arises from the *SongArt* network of the Institute of Musical Research, London, which the first author founded with Kathryn Whitney. *SongArt* seeks to bring theories of the lyric into dialogue with current experiences of performing song, so as to explore the nature of "liveness" in performance. With the collaboration of Paul Barker, we have set up a series of further dialogues between actors and musicians, singers and pianists, to investigate the benefits of cross-disciplinary role play in the search for lyric presence in performance. This paper draws insights from workshops centered on the preparations of pianist Maria Setiadi to "sing" Liszt's transcription of Beethoven's *An die ferne Geliebte*. These have explored the relevance of actor training techniques with the breath to the pianist, encouraged by the nature of the changes Liszt made to Beethoven's score. In the paper we seek to establish the significance of working with the breath, as a potent means of communicating the expanded span of Beethoven's work to an audience. Through engaging with the breath, as a singer would, the pianist is able to project specific lyric moments within the epic and dramatic sweep of Beethoven's cycle, including crucial moments at its beginning and end.

## **PIANO PERFORMANCE I**

### **The pianist's acoustical and motional expressions in the live performance of Schumann's *Träumerei***

*Haruka Shoda and Mayumi Adachi*

According to previous studies, expert performers construct their acoustical (i.e. durational, dynamical) and visual (i.e. motional) expressions by highlighting the structurally important points. However, it is still unclear whether such expressions are influenced by the presence of the audience. In the present study, we examined the effects of context (i.e. *audience present* versus *audience absent*) on expert pianists' acoustical and motional expressions in their performances of Robert Schumann's *Träumerei*. In the experiment, 13 pianists performed six pieces including *Träumerei* in front of 11-23 audience members. Either before or after the live performance, each pianist performed the same pieces without any audience. According to the functional data analyses for the duration, the dynamic range, and the motional range, the trough and the peak points within each parameter were in phase with the boundaries between the sections regardless of the context. The analyses also showed that the pianists amplified the ranges of the expressions at the trough and the peak within each parameter in front of their audiences. These results suggest that

sharing time and space with the audience amplifies the pianists' expressions in performing structurally salient points (e.g. phrase endings).

### **Playing hands together: Exploring the use of asynchrony as an expressive device**

*Jennifer MacRitchie and Hubert Eiholzer*

Pianists often use asynchrony with the purpose of making multiple voices more transparent or providing extra emphasis at particular locations. This study evaluates the perceptual effects of such asynchronies in performances of three pieces with varying textures: a Bach Fugue, a Brahms Intermezzo, and a Chopin Prelude. By varying onset times (+55 ms, 0, -55 ms) and key velocity values (0, +10 units) of the bass and melody voices of a pre-recorded professional performance on a Yamaha Disklavier, 11 different performances were synthesized. 21 participants were presented these performances in random order and asked three questions in consecutive sessions: How rich is the timbre? How transparent are the different voices? How expressive do you think this performance is and is it appropriate for the piece? Strong agreement is found for ratings of richness and transparency, but few significant differences appear between different levels of asynchrony and key velocity. ANOVAs revealed effects of asynchrony in Bach, and pianists differed from non-pianists in their ratings of transparency and expressiveness for Chopin and Brahms.

### **Piano playing and chronotype: Chronobiological influences on sensorimotor precision in pianists**

*Hans-Christian Jabusch, Floris Tijmen van Vugt, Marc Bangert, Katharina Treutler, and Eckart Altenmüller*

Chronotype-dependent circadian fluctuations of sensorimotor precision may be a challenge for musicians. We investigated pianists' sensorimotor precision in a relevant musical context in two different times of the day as well as its potential association with their chronotype. Twenty-one piano students were included in the study. Sleep habits were assessed applying the Munich Chrono Type Questionnaire. Mid-sleep time served as a marker for the individual chronotypes. Performance was tested in standardized scale playing twice on two different days: one test took place at 08:00, one at 20:00. Timing variability was assessed as (1) variability due to deviations that are present across trials (irregularity) and (2) variability between trials (instability) according to an established procedure. ANOVAs with performance parameters as dependent variables were calculated to assess potential interactions between pianist chronotype and recording time-point. With the instability of timing as a dependent variable, an interaction was seen between pianist chronotype and recording time-point ( $F_{1,19}=10.20$ ,  $p=0.004$ ,  $\eta^2=0.03$ ): the timing patterns of late chronotype pianists were more stable in the evening than in the morning, whereas early chronotype pianists did not show a difference between the two recording timepoints. We conclude that in different chronotypes, circadian performance differences may occur with respect to the timing instability.

## **MODELING AND ANALYZING IMPROVISATION**

### **Chords not required: Incorporating horizontal and vertical aspects independently in a computer improvisation algorithm**

*Martin Norgaard, Mariana Montiel, and Jonathan Spencer*

Most previous computer improvisation algorithms for tonal jazz create an output based primarily on the underlying chord progression. This approach may partly ignore melodic continuity often seen in transcriptions of traditional jazz artists. Here we suggest a different approach implemented as a computer algorithm that creates material solely based on probabilities related to past note choices. This approach aligns with theoretical work suggesting that stored motor patterns are the basis of improvised music. Our computer algorithm analyzes pitch and rhythm patterns from a given corpus and then creates improvisations using this information. We describe an example in which a corpus of 48 solos by jazz saxophonist Charlie Parker was used by our algorithm to create an improvisation of the same length. The artificial corpus contained pattern structures similar to that of the original corpus. In contrast, previous research by one of the authors showed that a chord-based computer algorithm generated an output with a pattern structure very different from that of the human improviser even though the same chord structure was used as input. Future work will add a vertical aspect to our model in which a given chord pattern influences note choices in addition to the current horizontal focus.

### **Ambient auditory feedback promotes synchronized improvisation**

*Lior Noy, Michal Rinott, and Maya Avni*

Performers describe unique moments of togetherness where it seems as if “the music played us.” We previously developed an experimental paradigm to study such moments using the mirror game, a practice from theater in which two actors improvise mirror-like motions together. Here, we study the effect of providing players with auditory feedback regarding their state of togetherness. Three pairs of experienced improvisers produced linear motions that were accurately traced. Players were instructed to create “interesting and synchronized” motion together. In feedback rounds, when moments of togetherness were detected, players were presented with an ambient “Omm” sound, growing richer with overtones as the synchronization time increases and gradually fading when players diverge. Players produced significantly longer togetherness periods, while the complexity of the motions was somewhat smaller, in feedback rounds. Auditory feedback can thus help players stay synchronized in the mirror game for longer durations, possibly at the expense of the richness of the motions. This effect might be similar to the process that encourages improvisers to continue their current movement sequence or musical line in response to audience applause. Our results have the potential to further the understanding of the dynamics of entering the state of togetherness in live performance.

### **Rhythmic entrainment in communicative, dyadic improvisation**

*Tommi Himberg, Marc R. Thompson, and Satinder P. Gill*

In our everyday interactions with others, we rhythmically entrain with the movements of each other’s bodies and voices, and this entrainment seems to share a quality with that of musical interaction. In order to understand this quality, we have taken the case of improvisation where both musical and linguistic interaction are considered as performance, and compare how we entrain when we jointly create music and stories together. Using a combination of qualitative and quantitative analysis of video and motion capture data, we have identified salient rhythmic moments (SRMs) that are heightened moments of rhythmic and empathic connection. A perceptual experiment has tested the effects of these SRMs on the perceived qualities of the performance.

## **CREATING COLLABORATIVE PERFORMANCE**

### **How good are groups at estimating time?**

*Philip Fine and Tina Vajsbaher*

Many factors affect people’s time estimation abilities, such as estimating how long a particular task took to complete. Most time estimation research to date has investigated individuals, but many tasks for which timing could be relevant are performed by groups. This study investigated how individuals’ prospective time estimates differ from those of groups. Eighty participants completed a word search task in groups of four. After the task, participants estimated how long the task took, how long they would have taken doing the task alone, and, finally, reached a group consensus on the time taken. Participants’ individual estimates of how long their group took were significantly longer than the actual time, but the group consensus correlated extremely well with the actual time taken. This suggests that groups are more accurate at estimating task duration than individuals, at least for this task.

### **The collective choral voice: Artistic impact on young singers of newly composed music**

*Joy Hill*

The context for the paper is the virtual absence in the singing literature of research into expert youth choirs and their engagement with newly composed repertoire. *Living Song* has provided a unique opportunity to address this need. It is a collaborative composition project with the RCM Junior Department (RCMJD) and the English Folk Dance and Song Society (EFDSS) where new compositions, based on folk songs originally collected by Vaughan Williams and Holst, are created by student composers and performed by my RCMJD Chamber Choir. The project led me to consider generic principles that enhance the art of collective choral performance by young voices through their engagement in newly composed repertoire. Semi-structured interviews were undertaken during 2012 in which eminent choral conductors and composers working with youth choirs responded to questions regarding the ways they select or compose repertoire in order to promote the highest level of musical performance. The findings from this empirical study suggest a need for further research into the artistic outcomes of new composition and performance projects, both in terms of the music produced by the composers and in relation to the artistic impact on the young singers and their ability to perform collectively.



### **Collaboration in the choral context: The contribution of conductor and choir to collective confidence**

*Michael Bonshor*

This qualitative study explored some of the factors influencing confidence levels amongst adult amateur choral singers. Three initial focus groups were completed, followed by sixteen individual interviews. The majority of interviewees had participated in a range of different types of choral singing, and each had performed with several different conductors. Emergent themes included: situational and environmental factors, such as rehearsal and concert venues, acoustics, choir formation, and spacing; the influence of other people, with special reference to conductors and fellow choral singers; and a number of significant issues related to choral direction, musical leadership, and group dynamics.

### **PIANO PERFORMANCE II**

#### **Fingers as individuals: The pianist's art of choosing the right fingering**

*Luís Pipa*

From the very early stages of keyboard playing, the question of how to choose which fingers to use was definitely a major concern. Fingers were divided into the “good” and “bad,” and used in accordance with the desired emphasis upon the musical text. The development of the keyboard instruments and the growing challenges of the repertoire led to the creation of numerous exercises and studies, with the indubitable purpose of achieving perfect equality and strength among the fingers. The ever-increasing rich, full-sounding tone of the modern piano inspired the pursuit of new strategies for improving keyboard technique. Awareness of the anatomical differences between the fingers was present, only now used to full advantage by pianists like Chopin, who recognized the possibility of using their characteristics to achieve distinctive musical results. The analysis of different types of fingerings and their implications may lead to solutions that will help to more effectively reach desired musical outcomes.

#### **Piano touch, timbre, ecological psychology, and cross-modal interference**

*Richard Parncutt*

The piano has a wide timbral range, and performance quality is often judged in timbral terms. Yet, despite decades of research, there are still fundamental disagreements about the nature and origin of piano touch. Scientists (acousticians) maintain that the timbre of a single tone cannot be varied independently of its loudness. Performers, humanities scholars, and concert audiences take the opposite for granted: timbre and loudness can be independently varied by gestural means. Both sides are right, but their implicit definitions of timbre differ, and both fail to clearly distinguish between physical measures and descriptions of subjective experience. Scientists assume that timbre depends only on physical sound parameters, but experiential parameters *generally* depend on concurrent input from other senses, the listener's relevant knowledge and expectations, and immediately preceding and following events. The paradox of timbre disappears if we accept, based on empirical evidence, that timbre generally depends on input from more than one sensory modality (weak synesthesia). Embodied corporality and conceptual metaphors are the norm, not the exception. Gestural and ecological approaches to timbre perception pose existential challenges to disembodied cognitive orientations.

#### **A sustainable playing technique for piano performance: Movement science and implications for curricula**

*Barbara James and Margaret Cook*

A sustainable technique is required for longevity in performing. However, factors in the music environment such as heavy action keyboards and repertoire with repetitive movements at high tempi and sound levels predispose body tissues to injury. A century ago, music pedagogues realized economy of muscle use was needed for an efficient technique and proposed theoretical concepts to take advantage, wherever possible, of the natural mechanical laws such as the ever-present gravity and rotational arm movement. Despite these hypotheses and recent empirical research demonstrating the value of using arm weight and forearm rotation, relevant significant findings proving their role in economic movement lack application generally to curricula, resulting in an ongoing high injury rate among pianists. Movement sciences are important in the analysis of technique and injury, thus this paper explores their application to piano playing, focusing on neural processes producing movement and structural and mechanical limitations of body tissues, plus the potential of mechanical laws. Implications are discussed for warming-up before playing, training children in technique methods, and employing music ergonomics as a model for teaching at graduate and

post-graduate levels to cater to performers, teachers (and their professional development), researchers, and applied science writers.

## **ANALYZING THE PERFORMANCE OF CONTEMPORARY MUSIC**

### **Exploring multi-temporalities: An orchestration of Luigi Nono's .....sofferte onde serene...**

*Paulo de Assis*

Collaborative creative practices between composers and performers have a long history. Famous examples include collaborations between Giovanni Gabrielli and Girolamo dalla Casa, Johannes Brahms and Joseph Joachim, Peter Tchaikovsky and Hans von Bülow, or, in the twentieth century, Luciano Berio and Cathy Berberian, and Luigi Nono and Maurizio Pollini. In .....*sofferte onde serene*... (1974-77) for piano and tape—written with and for Pollini—several new elements emerged in the musical language of Nono, including new modes of organizing “multi-temporalities,” with the piano and the tape following different paths on the same journey. As a result, renderings of this piece involve various degrees of uncertainty and unpredictability of sonic combinations—an aspect that is reinforced by the use of “shadow” sounds: similar sonorities that come sometimes from the piano, sometimes from the tape and that generate a perceptual (con)fusion for the listener. The author’s own transcription of this piece for orchestra in four groups aims at further exploring and developing specific practices of multi-temporality, focusing on the collaborative creative performance, where two conductors, reading two fully independent scores, have to develop a sense for a “chamber musically oriented” performance. Recently premiered in Cologne (Germany), this orchestration points to new modes of exposing and performing multi-temporal pieces.

### **The role of texture and musicians’ interpretation in understanding atonal music: Two behavioral studies**

*Maurizio Giorgio, Michel Imberty, and Marta Olivetti Belardinelli*

Two experiments aimed to inquire: (1) the role of performance and texture in the segmenting of a musical composition during the listening; (2) whether the structure perceived by the listeners depends on processes developing simultaneously with the listening or on an *a posteriori* synthesis; and (3) the role of expertise in segmentation. For each experiment 30 subjects were asked to attentively listen to two versions of an atonal composition, identify the architecture underlying the piece, and mark the boundaries between different segments by pressing the spacebar. The order of presentation of the two versions was balanced. In the first experiment the two performances differed in duration and in many dynamic aspects. In the second experiment the two performances differed only in duration. For both the first and the second experiments results showed a good number of coinciding segmentations in the two performances irrespective of the order of presentation. Musicians indicated a lower number of segmentations than not-musicians, even if many of the chosen boundaries remained the same. The results suggested that texture provided all of the necessary information for representing the pieces during the first listening.

### **Collaborative understandings in the preparation of a new work for viola and piano**

*Dawn Bennett and Diana Blom*

The interpretation of a musical work can draw on multiple sources, including aural experiences, metaphors, written texts, and other works by and interactions with the composer. These “experiential anchors” resonate with previous musical experiences to inform an “interpretive platform” from which a performer’s practice and performing process develops. As such, the first stage of learning a new work is vastly different for canonic repertoire than it is for a piece that is newly composed. This paper reports findings from a project of commissioned works that were received without explanatory program notes from the composers. This enabled a unique interrogation of the process through which an interpretative platform is built and negotiated. Focusing on a work for viola and piano composed by one of the authors, the collaborators share their individual interpretive frames with each other for the first time as part of the paper-writing process. The subsequent response and rethinking of the work, when underlying compositional thinking is given, is described as dialogue. The paper uncovers some of the differences and intersections that may lead to a collaborative interpretive platform. They also reveal insights into the hierarchical relationship between creator and interpreter.

## THE SCIENCE OF SINGING

### Effect of singing training on total laryngectomees wearing a tracheoesophageal voice prosthesis

*Fernanda Onofre, Hilton Marcos Alves Ricz, Telma Kioko Takeshita-Monaretti, Yuka A. Prado, and Lillian Neto Aguiar-Ricz*

The aim of this study was to assess the effect of a program of singing training on the voice of total laryngectomees wearing a tracheoesophageal voice prosthesis, considering the quality of alaryngeal phonation, vocal extension, and the musical elements of tuning and legato. Five laryngectomees wearing a tracheoesophageal voice prosthesis completed the singing training program over a period of three months, with exploration of the strengthening of the respiratory muscles and vocalization and with evaluation of perceptive-auditory and singing voice being performed before and after 12 sessions of singing therapy. After the program of singing voice training, the quality of tracheoesophageal voice showed improvement in the persistence of the general degree of dysphonia for the emitted vowels and for the parameters of roughness and breathiness. For the vowel “a,” the pitch was displaced to grave in two participants and to acute in one, and remained adequate in the others. A similar situation was observed also for the vowel “i.” After the singing program, all participants became in tune and most of them showed the presence of legato. The vocal extension improved in all participants. Singing training seems to have a favorable effect on the quality of tracheoesophageal phonation and on singing voice.

### Breathing imagery moderates vibrato rate

*Lynda Moorcroft, Dianna T. Kenny, and Jennifer Oates*

This study investigated acoustic change in singers’ vibrato following imagery and non-imagery tasks. One task, involving breathing imagery, produced significantly more moderate and regular vibrato rates. Another task, involving imagery unrelated to breath function, produced erratic but significantly slower vibrato rates. A non-imagery task related to breath function produced no significant changes. Sound pressure level results indicated that dynamic changes were not responsible for the changes observed in vibrato. The findings of this study indicate that breathing imagery regulates singers’ vibrato in a manner consistent with that of a more proficient, warmed-up voice.

### Position of the larynx during lyrical singing in professional and amateur female singers: Preliminary results

*Snizhana Drahan, Telma Kioko Takeshita-Monaretti, and Lillian Neto Aguiar-Ricz*

The aim of this study was to analyze the position of the larynx of professional and amateur singers during singing using measurements of the longitudinal distance between vocal folds and the hard palate. In the study 36 female singers were analyzed; 18 of them were professional singers and 18 were amateur, classified as soprano or mezzo-soprano. In order to obtain anatomical images, each participant underwent videofluoroscopy, being instructed to sing vocalizations in *do*, *re*, and *mi* major with an extension of one octave with the vowels “A,” “I,” and “U” sustaining the superior note. Descriptive statistics were adopted. There was no difference in the longitudinal distance between the vocal folds and the hard palate between sopranos and mezzo-sopranos in either the amateur or the professional group, and when the two groups were compared, identical values were detected. Amateur singers showed, while in rest, they had a shorter distance in the vowels “A” and “U” in tones *re* and *mi* and in the vowel “I” in tones *do*, *re*, and *mi*. Professional singers had the largest distance between the vocal folds and palate compared to the rest in all images, demonstrating the domination of extrinsic muscle adjustments for the production of singing voice.

## THEORETICAL PERSPECTIVES

### Mirror neurons: Imitation and emulation in piano performance

*Cristine MacKie*

Research in performance science has grown considerably during the last ten years. But despite the potential for this field to inform educational and professional practice across the arts, its application in the field of piano performance has been largely neglected. This neglect is not surprising, since the area is steeped in traditional methods of performance practice, and suffers also from a mind/body dualism. The pilot study described in this paper will suggest that skilled pianism cannot be achieved exclusively by pursuing the traditional route, in which the student and the teacher sit side by side throughout the piano lesson. It may be better achieved by including some collaboration with other disciplines such as musical analysis, neuroscience, and dance.

### **Communicating music: Structure, cognition, and expression**

*Ângelo Martingo*

Although expressive deviations have been shown to bear a close relation to music structure, as represented by generative theory, models are less accurate as the structural level decreases. The three empirical studies reported here were aimed at testing Lerdahl's Tonal Pitch Space (TPS) theory at phrase level on the performance and reception of the nine initial measures of Beethoven's *Waldstein Piano Sonata*, second movement. Results show (1) the relevance of TPS on the understanding of individual expressive behavior and (2) expert and naive listeners' higher rating of recordings in which expressive deviations correlate to music structure as represented by TPS.

### **Mental representation of music performance: A theoretical model**

*Gilvano Dalagna, Filipa Lã, and Graham F. Welch*

Different coexisting definitions regarding mental representation cause difficulties in the provision of a comprehensive theoretical model that can conceptualize mental representation in music performance contexts. Mental representation has been understood as an anticipatory plan of the actual music performance. It has been recognized to affect the quality of the performance; a greater refinement is likely to increase performance quality. Despite its additional suggested pedagogical importance to instrumental learning, its development, from practice to performance, is still poorly understood. Grounded in a systematic literature review, a theoretical model is here proposed aiming at the clarification of the concept of mental representation and its application in performance practices.

## **Keynote paper**

### **Rhythm, meter, drumming, and dance: A predictive systems view of an ancient aspect of music**

*W. Tecumseh Fitch*

Although the majority of research in music cognition concerns melody and harmony, rhythm and meter are some of the most fundamental aspects of music, particularly in a performance context. They have deep roots, since music and dance are closely connected in virtually all of the world's cultures. Furthermore, the distribution of isochronic music (with a steady beat or tactus) versus so-called "free rhythm" without such a pulse, suggests that isochronicity plays an important role in group synchronization rather than being a necessary component of melody. I first examine the isochronic pulse from the viewpoint of predictive systems theory (sometimes termed dynamical systems theory or nonlinear dynamics), suggesting that the fundamental function of isochronicity is to allow a group of individuals to synchronize their behavior, whether playing an instrument, singing, or dancing. I then turn to the biological and neural bases of rhythmic behavior. Despite a long tradition of belief that the ability to entrain to a musical beat is uniquely human, I review recent convincing evidence of entrainment in several non-human animal species (especially parrots and sea lions). This opens the door to experimental investigations of the ontogeny and neural basis of pulse entrainment that would be difficult or impossible in humans. Nonetheless, regarding meter (which I interpret as a hierarchically-structured interpretation of a pulse), there is much less work on animals, and it remains unclear whether animals interpret a pulse stream in terms of metrical structure. Finally, neural imaging data in humans shows a clear link between rhythmic perception and motor regions of the brain, suggesting a close link between rhythm and prediction/preparation in time. However, much of this work does not clearly distinguish between pulse perception and meter perception. There are some indications that perceiving meter (and coping with syncopation and other deviations from simple, superficial meter) may involve different brain regions from those involved in pulse entrainment, regions more classically associated with linguistic syntax. This suggests that a hierarchical model of meter is of more than notational convenience, but rather a fundamental component of rhythmic cognition.

## Institute of Music Acoustics, University of Music and Performing Arts Vienna

The University of Music and Performing Arts Vienna (mdw), is one of the world's oldest and largest universities of music, drama, and film, with over 800 staff and 3000 students. Founded in 1817, it is well-known for combining tradition with innovation in performance, science, and scholarship. The mdw hosts several research and training institutes, including the Max Reinhardt Seminar for drama, the Vienna Film Academy, the Arnold Schönberg Center, and the Institute of Music Acoustics (IWK).

The IWK was founded in 1980 with the aim of defining and investigating the Viennese performance tradition, reflected particularly by the traditional Viennese wind instruments. Today, the Institute is internationally renowned for its collaborations with instrument makers, researchers, and practicing musicians of the top Viennese orchestras. While providing undergraduate teaching for instrumentalists and research courses for graduate level education, the IWK hosts several nationally-funded and European research projects on instrument acoustics, music performance research, and sound experience design.

## Centre for Performance Science, Royal College of Music, London

The Royal College of Music (RCM) is one of the world's leading conservatoires, providing specialized musical education and professional training at the highest international level for performers and composers.

Founded in 2000, the Centre for Performance Science (CPS) is an internationally distinctive centre for research and knowledge exchange in music performance science. A central aim of the CPS is to remain alert to the particular mission and purpose of conservatoire training. Its position within a vibrant musical environment and focus on applied research distinguishes it from university-based centres with overlapping interests. The CPS offers teaching and supervised research opportunities at all levels of the RCM's undergraduate and postgraduate programs, including two advanced specialist degrees: the MSc and PhD in performance science.

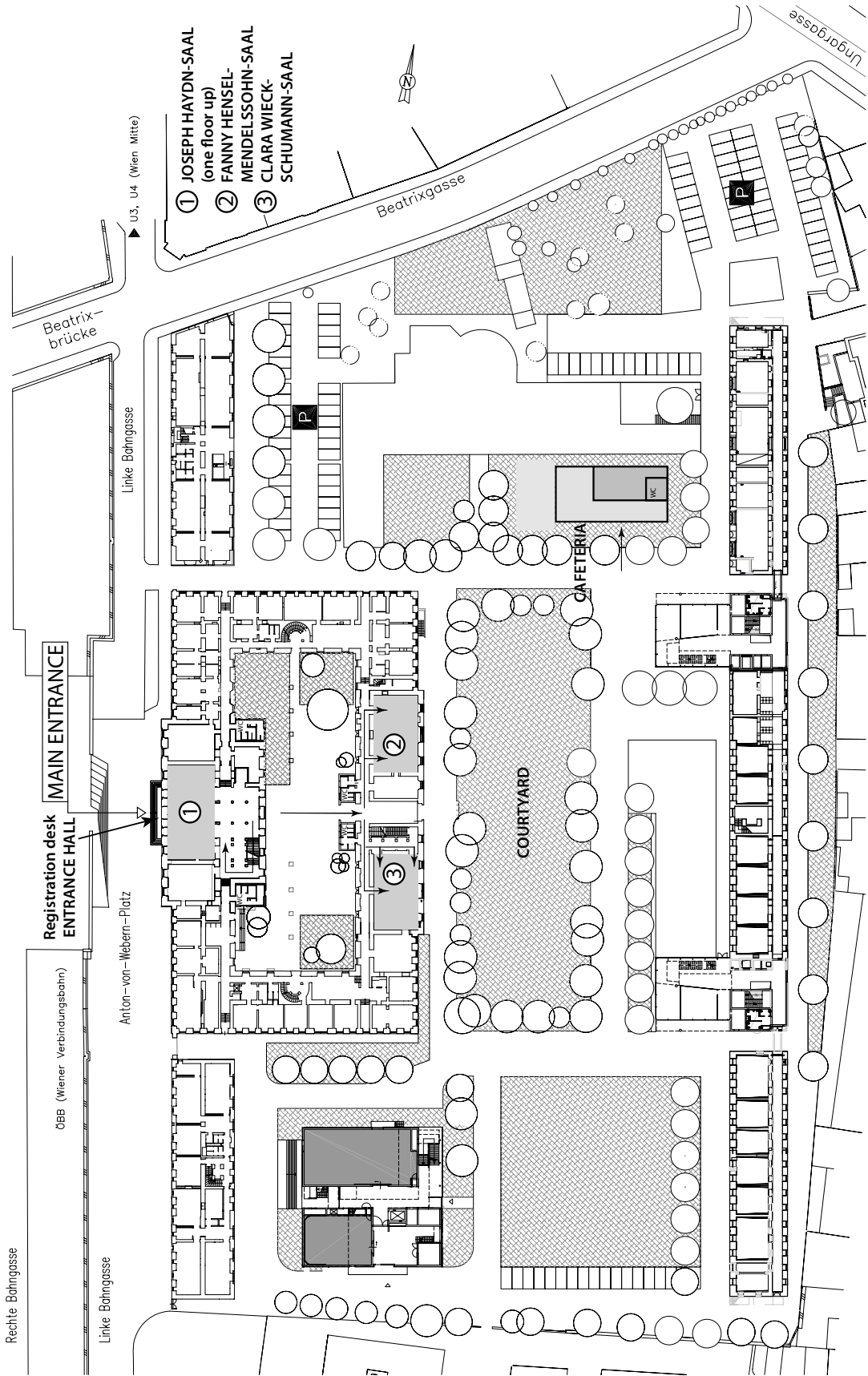
## Location map



University of Music and Performing Arts Vienna  
Anton-von-Webern-Platz 1, 1030 Vienna, Austria

UNIVERSITÄT FÜR MUSIK UND DARSTELLENDE KUNST WIEN  
CAMPUS ANTON-VON-WEBERN-PLATZ 1030 WIEN

Campus plan



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