Contents

Convened by

UNIVERSITY OF TORONTO
FACULTY OF MUSIC

RCM
LONDON

In partnership with

Social Sciences and Humanities Research Council of Canada
Conseil de recherches en sciences humaines du Canada
Canada

Welcome to ISPS 2011

On behalf of the research community of the University of Toronto, I extend a warm welcome to participants in the 2011 International Symposium on Performance Science.

The largest university in Canada, the University of Toronto has a proud tradition of teaching and research and is today ranked among the top 20 research-intensive universities worldwide. UofT's Faculty of Music has long been a Canadian leader in musical training and research. Its creative and performing artists have been the recipients of numerous national and international awards. Its musicologists, ethnomusicologists, theorists, and music educators are leaders in their fields, who have made significant contributions to the life of the University through their affiliations with the Jackman Humanities Institute, the Munk School of Global Affairs, the Ontario Institute for Studies in Education, and other organizations. The UofT Music Library, housed in the Edward Johnson Music Building, is recognized as one of North America's great collections. The Faculty's MacMillan Theatre and Walter Hall have witnessed many historic performances. Partnership relations with the Canadian Opera Company, the Toronto Symphony Orchestra, the Tafelmusik Baroque Orchestra, Nexus Percussion, the Gryphon Trio, the Toronto Wind Quintet, the St Lawrence String Quartet, the Canadian Brass, and other renowned ensembles constantly inform the artistic and pedagogical mission. More recently, the Faculty is engaged in an ambitious program of interdisciplinary research and international networking that brings music to the forefront of innovative inquiries in medicine, engineering, and science, as well as management, law, and education. It is particularly in this context that we welcome the presence of ISPS.

Wishing you all the best in your visit to Toronto and your time together at the Symposium,

Professor Paul Young
Vice-President, Research and International Relations
University of Toronto

Scientific committee

General information for delegates

Reception and information desk

On Wednesday, 24 August, a registration desk will be situated in the Main Lobby of the University of Toronto Faculty of Music from 11:00-13:00 (Edward Johnson Building, 80 Queen's Park, Toronto M5S 2C5). Thereafter, a registration and information desk will be situated at the same location from 08:30 on 25, 26, and 27 August.

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
- information booklet and map of Toronto

Additional copies of the conference program will be available at the registration and information desk or downloadable via the conference website, www.performancescience.org.

Delegate badge

Access to conference sites, 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 University of Toronto.

Messages and notice board

A message and notice board will be situated near the 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 the Faculty of Music Reception on +1 416 978 3750. For urgent matters, messages can be left with Lee Bartel, ISPS co-chair, on +1 416 524 2822.

Meals and refreshments

Refreshments (tea/coffee) and lunch will be available during breaks in the scheduled program (see pp.7-8 for times). The conference dinner will be served on Friday, 26 August, from 19:00 at *360*, the Restaurant at the CN Tower (301 Front Street West, Toronto M5V 2T6). Coach transportation to the CN Tower will depart from the Faculty of Music at 17:30, with stops at the Intercontinental Yorkville Hotel and New College Residences. The coach will depart from the CN Tower at approximately 21:30, stopping at the Faculty of Music, Intercontinental Yorkville, and New College on return.

Internet facilities

Wireless internet access will be available for delegates for the duration of the conference. Please ask at the registration and information desk if you need assistance with this or with other IT facilities.

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 main reception for the University of Toronto Faculty of Music is situated on entrance level of the Edward Johnson Building, where a first aid kit is located. In the event of an emergency, please notify university staff, who will be in attendance in all conference rooms throughout the event. In case of *fire* or if you require an *ambulance* or the *police*, dial 911 to notify the Emergency Services, then notify the nearest member of staff (*campus security:* +1 416 978 2222). For any other urgent issues, contact Lee Bartel, ISPS co-chair, on +1 416 524 2822.

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 run to time; therefore, session chairs have been instructed to cut short any papers that overrun 20 minutes. 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, 26 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 break period (10:00-10:30) on 26 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 26 August and should be removed by 16:00.

Quick reference timetable

Wednesday, 24 August 2011

11:00-13:00	Registration	Main Lobby
13:00-13:30	Welcome to ISPS 2011	Walter Hall
13:30-14:30	*Keynote address* Don McLean (University of Toronto) Science in the concert hall? Music in the lab? Perspectives on the role of research in higher music education	Walter Hall
14:30-15:00	Break (with performance and refreshments)	Walter Hall Lobby
15:00-16:30	*Thematic sessions* Musician's dystonia: Psychological and behavioral findings Performance analysis I Learning and teaching I	 Geiger Torel Room Boyd Neel Room Room 330
16:30-17:00	Break (with refreshments)	Walter Hall Lobby
17:00-18:30	*Thematic sessions* Musician's dystonia *(cont.)* Performance analysis II Learning and teaching II	 Geiger Torel Room Boyd Neel Room Room 330
18:30-19:30	Break	
19:30-	Concert (followed by reception)	Walter Hall Lobby

Thursday, 25 August 2011

08:30-09:00	Registration	Main Lobby
09:00-10:00	*Keynote address* Roger Kneebone (Imperial College London) The art, science, and simulation of performance	Walter Hall
10:00-10:30	Break (with performance and refreshments)	Walter Hall Lobby
10:30-12:00	*Thematic sessions* A major collaborative research initiative on singing: Focus on performance Physicality of performance Creativity and communication in performance	 Geiger Torel Room Boyd Neel Room Room 330
12:00-13:30	Lunch	Walter Hall Lobby
13:30-15:00	*Thematic sessions* A major collaborative research initiative on singing *(cont.)* Performers' health I Movement and embodied knowledge I	 Geiger Torel Room Boyd Neel Room Room 330
15:00-15:30	Break (with performance and refreshments)	Walter Hall Lobby
15:30-17:00	*Thematic sessions* The science of singing Performers' health II Movement and embodied knowledge II	 Geiger Torel Room Boyd Neel Room Room 330
17:00-17:15	Break	

17:15-18:00	*Graduate award paper* Colleen Skull (University of Toronto) Sustained excellence: Toward a model of factors sustaining elite performance in opera	Walter Hall
18:00-19:30	Break	
19:30-	Concert	Walter Hall

Friday, 26 August 2011

08:30-09:00	Registration	Main Lobby
09:00-10:00	*Keynote address* Virginia Wilmerding (University of New Mexico) Dance pedagogy: Myth versus reality	Walter Hall
10:00-10:30	Break (with performance and refreshments)	Walter Hall Lobby
10:30-11:30	Poster session	Main Lobby
11:30-13:00	*Thematic sessions* Empirical approaches to expressive strategies in harpsichord performance Perspectives on performance Evaluating performance	 Geiger Torel Room Boyd Neel Room Room 330
13:00-14:00	Lunch	Walter Hall Lobby
14:00-15:30	*Thematic sessions* Understanding vocal performance (workshop) Dynamic artistry: Unlocking sound potential (workshop) Solo and ensemble expertise	 Geiger Torel Room Boyd Neel Room Room 330
15:30-19:00	Break	
19:00-	Conference dinner	CN Tower

Saturday, 27 August 2011

08:30-09:00	Registration	Main Lobby
09:00-10:30	*Thematic sessions* Multimodal models of music performance The science of piano playing Performance anxiety	 Geiger Torel Room Boyd Neel Room Room 330
10:30-11:00	Break (with performance and refreshments)	Walter Hall Lobby
11:00-12:30	*Thematic sessions* Multimodal models *(cont.)* The science of drumming Imagery and performance	 Geiger Torel Room Boyd Neel Room Room 330
12:30-13:30	Lunch	Walter Hall Lobby
13:30-15:00	*Thematic sessions* Expression and interpretation The science of string playing Memory and attention in performance	 Geiger Torel Room Boyd Neel Room Room 330
15:00-15:15	Break	
15:15-16:15	*Keynote address* Roger Chaffin Thinking about performance: Memory, attention, and practice	Walter Hall
16:15-17:00	Closing remarks and announcement of ISPS 2013	Walter Hall

Wednesday, 24 August 2011

<table>
<tr><td>11:00-13:00</td><td colspan="3">REGISTRATION
Main Lobby, Faculty of Music, University of Toronto</td></tr>
<tr><td>13:00-13:30</td><td colspan="3">WELCOME TO ISPS 2011
To feature:
Toronto Children's Chorus
Elise Bradley artistic director
Michel Ross piano
Walter Hall</td></tr>
<tr><td>13:30-14:30</td><td colspan="3">KEYNOTE ADDRESS
Don McLean
University of Toronto
Science in the concert hall? Music in the lab?
Perspectives on the role of research in higher music education (p.22)
Chair:
Colin Lawson
Walter Hall</td></tr>
<tr><td>14:30-15:00</td><td colspan="3">BREAK
(with performance and refreshments)
To feature:
Colleen Skull soprano
Walter Hall Lobby</td></tr>
<tr><td>15:00-16:30</td><td>SYMPOSIUM
Musician's dystonia: Psychological and behavioral findings and their consequences for therapy
Chair and discussant:
Anke Steinmetz
Geiger Torel Room
Altenmüller, Boullet et al.
Behavioral retraining in focal dystonia: Results of a long-term follow up in 72 pianists (p.22)
Jabusch, Paulig et al.
Improved motor control after alteration of somatosensory input: Prognostic value of "glove effect" (p.23)
Lee, Chadde et al.
Phenomenology of dystonic and task-specific tremor in musicians: A descriptive study (p.23)</td><td>THEMATIC SESSION
Performance analysis I
Chair:
Cristina Gerling
Boyd Neel Room
Bisesi, Parncutt, Friberg
An accent-based approach to performance rendering: Music theory meets music psychology (p.23)
Handelman, Sigler
Automated performance analysis of virtuosic music for string instruments (p.24)
Grachten, Widmer
A method to determine the contribution of annotated performance directives in music performances (p.24)</td><td>THEMATIC SESSION
Learning and teaching I
Chair:
Tânia Lisboa
Room 330
López Íñiguez, Municio
Conceptions of conservatoire elementary level students with regard to teaching string instruments (p.24)
Araújo, Cruz, Almeida
Inspirational teachers: Their role in the development of excellence in professional dancers (p.24)
Marin-Oller et al.
Conceptions about instrumental teaching and learning in woodwind students (p.25)</td></tr>
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16:30-17:00	BREAK (with refreshments) Walter Hall Lobby		
17:00-18:30	SYMPOSIUM Musician's dystonia (cont.) *Chair and discussant:* Anke Steinmetz Geiger Torel Room Spector, Enders *et al.* Musician's dystonia and comorbid anxiety: Two sides of one coin? (p.23) Steinmetz Symposium discussion	THEMATIC SESSION Performance analysis II *Chair:* Cristina Gerling Boyd Neel Room Flossmann, Widmer Toward a model of performance errors: A qualitative review of Magaloff's Chopin (p.25) Nonogaki, Shimazu *et al.* Use of spline curve to evaluate performance proficiency of Czerny piano piece (p.25) Stambaugh An examination of a MIDI wind controller for use in instrumental research (p.25)	THEMATIC SESSION Learning and teaching II *Chair:* Tânia Lisboa Room 330 Picone Lost in Eden: Guided practice for the musical tourist (p.26) Wise, James, Rink Learning to be a creative performer: Developing mixed methods to understand teachers' and students' approaches and constructs (p.26)
18:30-19:30	BREAK		
19:30-	CONCERT (followed by reception) *To feature:* The Windermere String Quartet, with Colin Lawson *clarinet* The Concert Opera Group, with Darryl Edwards *artistic director* and Kathryn Tremills *piano* Walter Hall		

Thursday, 25 August 2011

<table>
<tr><td>08:30-09:00</td><td colspan="3">REGISTRATION
Main Lobby, Faculty of Music, University of Toronto</td></tr>
<tr><td>09:00-10:00</td><td colspan="3">KEYNOTE ADDRESS
Roger Kneebone
Imperial College London
The art, science, and simulation of performance (p.28)
Chair:
Aaron Williamon
Walter Hall</td></tr>
<tr><td>10:00-10:30</td><td colspan="3">BREAK
(with performance and refreshments)
To feature:
University of Toronto Wind Instrumentalists
Walter Hall Lobby</td></tr>
<tr><td>10:30-12:00</td><td>SYMPOSIUM
A major collaborative research initiative on singing: Focus on performance
Chair and discussant:
Frank Russo
Geiger Torel Room
Cohen
Advancing interdisciplinary research in singing: A performance perspective (p.28)
Ginsborg, Fine, Barlow
Have we made ourselves clear? Singers and non-singers' perceptions of the intelligibility of sung text (p.28)
Knight
Adults identifying as "non-singers" in childhood: Cultural, social, and pedagogical implications (p.29)</td><td>THEMATIC SESSION
Physicality of performance
Chair:
Rosie Perkins
Boyd Neel Room
Clark, Holmes, Redding
Investigating the physiological demands of musical performance (p.29)
Wyon, Twitchett et al.
The day-to-day workload of ballet dancers (p.30)
Thomson, Jaque
Psychophysiological study: Ambulatory measures of the ANS in performing artists (p.30)</td><td>THEMATIC SESSION
Creativity and communication in performance
Chair:
Bruno Gingras
Room 330
Schankler, Francois, Chew
Preparing for the unpredictable: Identifying successful performance strategies in human-machine improvisation (p.30)
Thompson
Expressive performance in music: Mapping acoustic cues onto facial expressions (p.30)
Hewitt
Choreographic approaches to music composition for a new musical interface: The eMic (p.31)</td></tr>
<tr><td>12:00-13:30</td><td colspan="3">LUNCH
Walter Hall Lobby</td></tr>
</table>

13:30-15:00	SYMPOSIUM A major collaborative research initiative on singing (cont.) *Chair and discussant:* Frank Russo Geiger Torel Room Lidji, Palmer *et al.* Entrainment to speech and song (p.29) Young, Nicol Perspectives on singing and performance in music therapy (p.29) Russo Symposium discussion	THEMATIC SESSION Performers' health I *Chair:* Hans-Christian Jabusch Boyd Neel Room Clemente, Coimbra *et al.* Can infrared thermography be a diagnostic tool for myofascial pain in wind and string instrument players? (p.31) Lourenço, Clemente *et al.* The assessment of trapezius muscle symptoms of piano players by the use of infrared thermography (p.31) Teixeira, Lã, Silva Head and scapular posture in flutists (p.31)	THEMATIC SESSION Movement and embodied knowledge I *Chair:* Emma Redding Room 330 Li "What am I doing?" Adolescent males and their stories in dance (p.32) Rodman Re-inventing the body image: A pilot project in a boys' secondary school (p.32) Xarez Dances of Cape Verde: Tempo, preferences, entrainment (p.32)
15:00-15:30	BREAK (with performance and refreshments) *To feature:* The Ben McConchie Quartet, with Karl Schwonik, Mark Godfrey, and Ali Berkok Walter Hall Lobby		
15:30-17:00	THEMATIC SESSION The science of singing *Chair:* Frank Russo Geiger Torel Room MacDonald, Hopyan, Gordon Cochlear implant singing study (p.32) Devaney, Wild, Fujinaga Intonation in solo vocal performance: A study of semitone and whole tone tuning in undergraduate and professional sopranos (p.33) Harler-Smith, Reimer The implications of register sensation in the female characters of Mozart's *Le nozze di Figaro* (p.33)	THEMATIC SESSION Performers' health II *Chair:* Hans-Christian Jabusch Boyd Neel Room Steinmetz, Claus *et al.* Sensorimotor alterations in violinists/violists with neck pain (p.33) Dahl, Großbach, Altenmüller Good playing practice when drumming: Influence of tempo on timing and preparatory movements for healthy and dystonic players (p.33) Marin, Bhattacharya Getting into the zone: Trait emotional intelligence predicts flow experience in piano performance (p.33)	THEMATIC SESSION Movement and embodied knowledge II *Chair:* Emma Redding Room 330 Wyon, Clarke, Thoms Is it their bodies that let them down? Dancing past 35 years old (p.34) Gualda, Winter Studying embodied knowledge through modeling performer's evaluation parameters: A longitudinal examination (p.34) Demos, Frank, Chaffin Understanding movement during performance: A recurrence quantization approach (p.34)

17:00-17:15	BREAK
17:15-18:00	GRADUATE AWARD PAPER Colleen Skull University of Toronto Sustained excellence: Toward a model of factors sustaining elite performance in opera (p.34) *Chair:* Daniela Coimbra Walter Hall
18:00-19:30	BREAK
19:30-	CONCERT *To feature:* Children's Dance Project, with Jennifer Swan *artistic director* Ritmundi Brazilian Music Quartet Walter Hall

Friday, 26 August 2011

08:30-09:00	REGISTRATION Main Lobby, Faculty of Music, University of Toronto	
09:00-10:00	KEYNOTE ADDRESS Virginia Wilmerding University of New Mexico Dance pedagogy: Myth versus reality (p.36) *Chair:* Darryl Edwards Walter Hall	
10:00-10:30	BREAK (with performance and refreshments) *To feature:* Opera a Casa, with Mia Bach and Steven Philcox *piano* Walter Hall Lobby	
10:30-11:30	POSTER SESSION Main Lobby	
	Allen, Simmons *et al.*	Characterizing accomplished musicians' learning over time (p.36)
	Begosh, Chaffin	Constraints on memory for verse (p.36)
	Bento, Clift, Hancox	Coping with performance anxiety: Choral singing, psychological states, and cortisol (p.37)
	Bernays, Traube	Verbal expression of piano timbre: Multidimensional semantic space of adjectival descriptors (p.37)
	Burt-Perkins, Williamon	"I kind of get lost in it": Experiences of learning to perform music in older adulthood (p.37)
	Cerqueira, Zorzal, de Ávila	Music performance learning model (p.37)
	Choa	The art of "repetitive practicing": Torture or meditation? (p.38)
	Chua	Reaching for the stars: Dance talent program at Singapore International School (Hong Kong) (p.38)
	Chueke	Three stages of listening during preparation and execution of a piano performance: Exchanges on the model and its application (p.38)
	Clark, Holmes *et al.*	The role and value of implementing health screening programs within music conservatoires (p.38)
	dos Santos, Gerling	Piano repertoire preparation from a praxial perspective (p.39)
	Fine, Alufa	A steady pace: The effects of musical expertise on tempo memory (p.39)
	Flória-Santos *et al.*	Qigong, singing, and health: A possible composition? (p.39)
	Harris, de Jong	The role of cerebral resonance behavior in the control of music performance: An fMRI study (p.39)

10:30-11:30	POSTER SESSION (cont.)	
	Harris, de Jong et al.	Non score-dependency: Theory and assessment (p.40)
	Hastings	How expert pianists interpret scores: A hermeneutical model of learning (p.40)
	Lin, Zhou, Huang	Piano concerto "Yellow River": Chinese pianism in the second half of twentieth century (p.40)
	López Íñiguez, Municio	From traditional to constructive practices in music education: Materials with which to study conceptual change in string teachers (p.41)
	MacArthur	Behind closed doors: Emotional abuse in the music studio (p.41)
	MacKie, Hussein	An inquiry into the function of the torso and its potential for a relationship with the music (p.41)
	Martingo, Coimbra	Taste, again: Naïve listener's preferences of performed tonal music (p.41)
	Mathias, Palmer *et al.*	Effects of meter and serial position on memory retrieval during music performance (p.42)
	McAlvin	Schenkerian analysis as generator: Stanislavski's "given circumstances" (p.42)
	Monk	Pansonic coordination on the drum set: The synthesis of the essential components in groove-based improvisation (p.42)
	Papatzikis	Performance implications of instructional material in instrumental music education: A case study (p.42)
	Santos-Luiz, Coimbra, Andrade	The effects of music tuition on academic achievement in Portuguese 8th year students (p.43)
	Stambaugh	Repetition and judgment of learning in wind instrument practice (p.43)
	van Vugt, Hälbig *et al.*	The musician doctor: A musical evaluation of treatments for movement disorders (p.43)
	Vezzá, Pereira	Tuning movement: Body education in teaching music instruments (p.43)
	Wasley, Williamon, Taylor	A comparison of music performance anxiety to a laboratory stressor (p.44)
	Williamson	John Dewey and F. M. Alexander: Habit and performance skills (p.44)
	Zorzal, Cerqueira, de Ávila	Investigating time relations in musical instrument's masterclasses (p.44)

11:30-13:00	SYMPOSIUM Empirical approaches to the study of expressive strategies and aesthetic responses in harpsichord performance *Chair:* Werner Goebl Geiger Torel Room Gingras, Asselin, McAdams Disentangling performer- and piece-specific influences on interpretative choices: A comparison across three harpsichord pieces (p.44) Gingras, Goodchild *et al.* Exploring interrelationships between melodic expectations, tempo variations, and perceived tension in performances of an unmeasured prelude for harpsichord (p.45) Koren, Gingras Perceiving individuality in musical performance: Recognizing harpsichordists playing different pieces (p.45)	THEMATIC SESSION Perspectives on performance *Chair:* Jane Ginsborg Boyd Neel Room Gritten The problem with performing (p.45) Lawson The British clarinet school: Legacy and legend (p.46) Sharon, Vatikiotis-Bateson *et al.* Breaking traditions: Art song theatre cognitive shifts through staged modalities (p.46)	THEMATIC SESSION Evaluating performance *Chair:* Rosie Perkins Room 330 Alessandri, Eiholzer *et al.* Investigating critical practice (p.46) Masaki, Hechler *et al.* Piano performance assessment: Video feedback and the Quality Assessment in Music Performance Inventory (QAMPI) (p.47) Gerling, dos Santos An evaluation of parameters in performance: The effects of aural and visual stimuli (p.47)
13:00-14:00	LUNCH Walter Hall Lobby		
14:00-15:30	WORKSHOP Understanding vocal performance: Excavating and exhibiting life's voice Geiger Torel Room MacDonald This workshop provides tools of excavation for singing at a variety of stages and ages through demonstration, discussion, and performance; voice sampling of childhood, adolescence, young adult, professional, and late adult singing is included, and attendee participation is encouraged (p.48)	WORKSHOP Dynamic artistry: Unlocking sound potential Boyd Neel Room Koga, Johnson Using aural, kinesthetic, and visual cues through the use of biofeedback from the ProForma Vision sEMG system and the Nintendo Wii Balance Board, this workshop demonstrates how the art of dynamic balancing can help unlock core sound and artistic potential in a healthful, vital way (p.48)	THEMATIC SESSION Solo and ensemble expertise *Chair:* Daniela Coimbra Room 330 Lisboa, Chaffin, Logan A self-study of practice: Words versus action in music problem solving (p.47) Tro Ensemble performance: The sum of performers? (p.47)

15:30-17:30	BREAK
17:30-	COACH TO CN TOWER (Departs from Faculty of Music, with stops at the Intercontinental Yorkville Hotel and New College Residences) Faculty of Music / Intercontinental Yorkville / New College
19:00-	CONFERENCE DINNER *360 The Restaurant at the CN Tower*, one of Toronto's finest, features unforgettable food combined with a magnificent revolving view of Toronto more than 351 metres (1,151 ft) below. *360* holds one of the most extensive wine selections in Toronto, featuring more than 550 labels from around the world. On 8 November 2006, *360* received the Guinness World Record for the World's Highest Wine Cellar. Return coach transportation will be provided from the conference venue to the CN Tower. See the information sheet in the delegate pack for further information. CN Tower, 301 Front Street West, Toronto M5V 2T6

Saturday, 27 August 2011

08:30-09:00	REGISTRATION Main Lobby, Faculty of Music, University of Toronto		
09:00-10:30	SYMPOSIUM Multimodal models of music performance *Chair:* Caroline Palmer Geiger Torel Room Russo, Chan, Edwards When vocal training masks structure: Individual differences in visual aspects of sung interval size (p.50) Pfordresher Poor-pitch singing as an inverse model deficit: Imitation and estimation (p.50) Livingstone, Palmer *et al.* Facial expressions in vocal performance (p.50)	THEMATIC SESSION The science of piano playing *Chair:* Aaron Williamon Boyd Neel Room MacKie Protecting the pianist's hand: The *carrezando* touch and more (p.52) Tzotzkova Exploring real-time sonic adjustments in the performance of notated music (p.52)	THEMATIC SESSION Performance anxiety *Chair:* Jane Ginsborg Room 330 Lã, Marinho *et al.* Electrophysiological markers and pianists' anxiety: A preliminary study (p.52) Wasley, Williamon, Taylor An investigation into the acute effect of exercise on musical performance (p.52) Bissonnette, Dubé *et al.* The effect of virtual training on music performance anxiety (p.53)
10:30-11:00	BREAK (with performance and refreshments) *To feature:* University of Toronto Percussionists Walter Hall Lobby		
11:00-12:30	SYMPOSIUM Multimodal models of music performance (cont.) *Chair:* Caroline Palmer Geiger Torel Room Palmer, Loehr Sensorimotor integration in solo and duet performance (p.50) Schober, Levine Visual and auditory cues in jazz musicians' ensemble performance (p.51) Davidson, Chung Two comparative case studies of facial gesture and bodily expression in contemporary interpretations of *Liebestraum* by Franz Liszt (p.51)	THEMATIC SESSION The science of drumming *Chair:* Lee Bartel Boyd Neel Room Kilchenmann, Senn "Play in time, but don't play time": Analyzing timing profiles in drum performances (p.53) Konishi, Miura Estimating musical score of drum performance based on the Bayesian method (p.53) Konishi, Miura Use of relationship between characteristics of rebound and surface EMG of arms to measure physiological load during drum performance (p.53)	THEMATIC SESSION Imagery and performance *Chair:* Terry Clark Room 330 Davidson-Kelly, Hong *et al.* An fMRI study of expert musical imagery (p.54) Bishop, Bailes, Dean Musical expertise and the planning of expression during performance (p.54) Fine, Bravo Rehearsal away from the instrument: What expert musicians understand by the terms "mental practice" and "score analysis" (p.54)

<table>
<tr><td>12:30-13:30</td><td colspan="3">LUNCH
Walter Hall Lobby</td></tr>
<tr><td>13:30-15:00</td><td>THEMATIC SESSION
Expression and interpretation
Chair:
Werner Goebl
Geiger Torel Room
Miura, Mito, Kawakami
Expression of basic emotion on playing the snare drum (p.54)
Ohriner
What can we learn from idiosyncratic performances? Exploring outliers in corpuses of Chopin renditions (p.55)
Flossmann, Widmer
Toward a multilevel model of expressive piano performance (p.55)</td><td>THEMATIC SESSION
The science of string playing
Chair:
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Boyd Neel Room
Schoonderwaldt, Altenmüller
Mastering the violin: Motor learning in complex bowing skills (p.55)
Hall, O'Donnell, Bailey
BowScribe: Supporting the violinist’s performance model (p.55)
Robidas
Designing a didactic tool to facilitate the integration of improvisation in the teaching of violin: Content of the final prototype (p.56)</td><td>THEMATIC SESSION
Memory and attention in performance
Chair:
Terry Clark
Room 330
Cheng, Heiß et al.
Attentional foci in piano performance (p.56)
Kaastra
Annotation and the coordination of cognitive processes in Western Art Music performance (p.57)
Harper, Henriques et al.
Slow down and learn: Pianists and memory (p.57)</td></tr>
<tr><td>15:00-15:15</td><td colspan="3">BREAK</td></tr>
<tr><td>15:15-16:15</td><td colspan="3">KEYNOTE ADDRESS
Roger Chaffin
University of Connecticut
Thinking about performance:
Memory, attention, and practice (p.57)
Chair:
Lee Bartel
Walter Hall</td></tr>
<tr><td>16:15-17:00</td><td colspan="3">CLOSING REMARKS and ANNOUNCEMENT OF ISPS 2013
Walter Hall</td></tr>
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Abstracts

Wednesday, 24 August 2011

Keynote paper

Science in the concert hall? Music in the lab? Perspectives on the role of research in higher music education

Don McLean

What is the position of musical training and research in higher education? Conservatoires and university schools of music face new accountability expectations in professional productivity and research outcomes. How are we to cope with these new challenges? How are we to lead them? What happens when science hits the concert hall? When music meets the lab? This presentation reviews the current change state of scientific inquiry in higher music education. It is in part an international overview of the field, one that briefly examines some past models and surveys developments currently underway in the United States, Canada, Europe, and Australia. It is also a shared reflection of the author's personal experience in helping to build CIRMMT (the Centre for Interdisciplinary Research in Music Media and Technology) at the Schulich School of Music of McGill University from 2001-10. It ultimately returns to a consideration of the fundamentals of musical experience, creativity, and research. Paths and pitfalls, organizations and infrastructures: what do we need to do to ensure a strong future for the scientific study of musical performance and for the place of music in higher education and society?

Thematic Sessions

SYMPOSIUM: MUSICIAN'S DYSTONIA: PSYCHOLOGICAL AND BEHAVIORAL FINDINGS AND THEIR CONSEQUENCES FOR THERAPY

Behavioral retraining in focal dystonia: Results of a long-term follow up in 72 pianists

Eckart Altenmüller, Laurent Boullet, Maricruz Gomez-Pellin, and Hans-Christian Jabusch

Focal dystonia in musicians (MD) is a task-specific movement disorder with a loss of voluntary motor control. Several treatment options are available. Besides pharmacological intervention with anticholinergic drugs or local injection therapy with botulinumtoxin, behavioral retraining has been increasingly applied in different groups of MD-instrumentalists. Results have been mixed and a valid long-term follow-up is still missing. Seventy-two pianists with MD were included in the study. Motor control was assessed using MIDI-based scale analysis. Temporary unevenness of inter-onset intervals (IOI) in scale playing was previously found to be a reliable and valid indicator of motor control in pianists with and without MD. After the first measurements, pianists entered a retraining program, developed by the second author. Basic principles of the retraining procedure can be divided in a "deprogramming" phase, in which incorrect movements at the instrument are identified. A "correct" posture of the hand is established using basic exercises. Subsequently, in a second phase, strengthening of weak muscle groups and the acquisition of an internal representation of simple movements is achieved. The third part of the retraining course starts after establishing a muscular equilibrium and control of exaggerated involuntary flexion. During this procedure, the basic constituents of piano technique are re-established. The retraining process is done under visual feedback from unusual perspectives using digital cameras. During the observation period (mean=42 months, range=3-72 months), 50% of the pianists improved according to objective measures. Complete restoration of the motor abilities was rarely achieved. However, with reduced workload, adapted practicing strategies, and change of repertoire, even in patients who did not display objective improvement of motor control on the piano, resumption of professional activities such as public performance and recordings was possible. In conclusion, while behavioral retraining is a valuable therapeutic option, prognostic factors determining the rate of success in an early stage of this long procedure remain to be identified.

Improved motor control after alteration of somatosensory input: Prognostic value of "glove effect" in pianists with dystonia

Hans-Christian Jabusch, Jakobine Paulig, Michael Großbach, Laurent Boullet, and Eckart Altenmüller

Musician's dystonia (MD) impairs motor control and musical performance. Alteration of somatosensory input (e.g. by wearing a latex glove) may improve motor control in some MD patients. The potential association between this so-called sensory trick phenomenon and the outcome after consequent treatment with botulinum toxin and/or pedagogical retraining was assessed in 24 pianists with MD using objective performance measures. Outcomes were significantly better in those patients with a significant pre-treatment sensory trick response (positive glove effect) than in others. The glove effect seems to have a prognostic value in the treatment of patients with MD.

Phenomenology of dystonic and task-specific tremor in musicians: A descriptive study

André Lee, Mareike Chadde, Floris T. van Vugt, and Eckart Altenmüller

Dystonia is a movement disorder characterized by an involuntary contraction of antagonist muscles leading to a flexion or extension, which occurs in musicians in the context of a highly over-trained fine motor task. A sensory trick is sometimes observed, leading to an amelioration of symptoms. In certain musicians suffering from dystonia, a tremor of the affected body part can be observed. Our aim is to describe two tremor syndromes that have been defined in the context of dystonia: (1) dystonic tremor as a focal, mainly postural- or action-tremor in one body part affected by dystonia, showing an irregular amplitude with a frequency mostly below 7 Hz and (2) dystonia-associated tremor as a tremor in musicians suffering from dystonia but in a body part not affected by dystonia. A second form of tremor in musicians is the "primary bowing tremor" in string instrument players, a task specific tremor that occurs only while playing the string instrument. No signs of dystonia are present in these musicians.

Musician's dystonia and comorbid anxiety: Two sides of one coin?

June T. Spector, Leonie Enders, Eckart Altenmüller, Alexander Schmidt, Christine Klein, and Hans-Christian Jabusch

We sought to characterize anxiety and other psychological conditions in musicians with focal dystonia (MD) and to determine whether a significantly higher degree of these conditions is present in musicians with MD compared with healthy musicians and non-musicians. Psychological conditions were studied in 44 professional musicians with MD, 45 healthy musicians, and 44 healthy non-musicians using the State-Trait Anxiety Inventory (STAI) and NEO-Five-Factors Inventory (NEO-FFI). Musicians with MD displayed significantly increased levels of anxiety and neuroticism compared with healthy musicians and non-musicians. The observed lack of correlation between anxiety and the duration of dystonia suggests that anxiety may not be a psycho-reactive phenomenon and is consistent with the hypothesis that anxiety and MD share a common pathophysiological mechanism.

PERFORMANCE ANALYSIS I

An accent-based approach to performance rendering: Music theory meets music psychology

Erica Bisesi, Richard Parncutt, and Anders Friberg

Accents are local events that attract a listener's attention and are either evident from the score (immanent) or added by the performer (performed). Immanent accents are associated with grouping, meter, melody, and harmony. In piano music, performed accents involve changes in timing, dynamics, articulation, and pedaling; they vary in amplitude, form, and duration. Performers tend to "bring out" immanent accents by means of performed accents, which attracts the listener's attention to them. We are mathematically modeling timing and dynamics near immanent accents in a selection of Chopin Preludes using an extended version of *Director Musices* (DM), a software package for automatic rendering of expressive performance. We are developing DM in a new direction, which allows us to relate expressive features of a performance not only to global or intermediate structural properties, but also accounting for local events.

Automated performance analysis of virtuosic music for string instruments

Eliot Handelman and Andie Sigler

We present an interactive program for analysis of performance possibilities for violin, viola, and cello music. The user is offered the full range of fingering options, together with structured methods for exploring, interpreting, and ultimately narrowing the possibility space to a few desirable choreographies for an entire piece. Fingerings are suggested based on performance structures such as *arpeggiation*, *axis* fingerings in which fingers are prepared in advance, and *bariolage* (patterned bowings). The program, which can be obtained at www.computingmusic.com, is intended as an aid for novices and composers, as an analytical resource, and as a component of an autonomous composing program.

A method to determine the contribution of annotated performance directives in music performances

Maarten Grachten and Gerhard Widmer

Interpreting notated music and performing it expressively is a complex skill that requires years of practice. In the quest for understanding this phenomenon, a question that arises naturally is to what degree performance directives annotated in the score affect expressive variations of tempo and loudness. Computational models of musical expression typically focus on musical structure and do not explicitly take into account annotated performance directives. The objective of the method presented here is to determine the degree to which loudness directives can account for expressive variations in loudness as measured from performances. To this end, we represent loudness directives by mathematical functions and use these to approximate measured loudness curves. This approximation yields coefficient values that represent how strongly each directive is reflected in the performance. Furthermore, the residual loudness curve after subtracting the model fit provides a clearer view on other, non-explicit factors that influence expressive loudness variations.

LEARNING AND TEACHING I

"Good music teachers should…" Conceptions of conservatoire elementary level students with regard to teaching string instruments

Guadalupe López Íñiguez and Juan Ignacio Pozo Municio

Conceptions of teaching and learning (T&L) are becoming more and more relevant in investigations, both with children and with adults. They are important because a constructivist curriculum is demanding for conservatoires, and so teachers and students should reflect on how they conceive T&L, evolving from basic to complex conceptions or approaches to T&L. According to the *direct* conception, the simplest one, learning means getting results or musical products, usually defined as "a good sound" in the technical domain, which is achieved through repetitive practice. The *interpretative* approach, which is slightly more complex than the previous one, assumes the involvement of cognitive activity by the student, even if the processes of a technical procedure are sorted out by the teacher. It is clear and desirable that these two traditional approaches to teaching should be changed in order to promote the *constructive* conception, which focuses on how to coordinate the mental activity of the student with the motor procedures needed for instrumental performance, by means of working with the body and reflecting on practice, with the teacher as a guide. Following our theoretical framework, we developed videos of dilemmas in order to assess the conceptions held by 60 conservatoire elementary level students, according to two variables: *developmental-evolutionary* and *teaching approach* (traditional vs. constructive).

Inspirational teachers: Their role in the development of excellence in professional dancers

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

In the study of outstanding performers, research has established the important role of significant people at different stages of excellence development. Specifically, teachers and mentors seem to have a central role in this process, contributing to the investment and persistence of individuals in learning, developing, and mastering a given task, as to professional socialization and influence. In this study, types of support and influence of teachers and mentors at different stages of dancers' excellence pathways are identified and analyzed. Using a case study approach, four dancers nominated for revealing excellence in performance and being actively engaged in their field were interviewed. Results confirm past research on the influential role of teachers and mentors in talent and expertise development. Dancers identify significant teachers and choreographers in their careers, particularly their important support on skill acquisition and mastery. Also,

their role on dancers' careers as "inspirational teachers/choreographers" was also referred to. Reflections on future research are discussed.

How do I learn to play my instrument? Conceptions about instrumental teaching and learning in woodwind students

Cristina Marin Oller, Puy Pérez-Echeverría, and Nora Scheuer

In this article, we analyze the conceptions that woodwind students hold about how we learn to play an instrument and which is the best way to teach it. Conceptions and beliefs about the nature of knowledge and its acquisition have been investigated in several domains. That kind of research helps us to understand how students and teachers conceive their teaching and learning processes, since these ideas underlie the processes themselves. Sixty-eight Spanish woodwind students from three different grades completed a multiple-choice questionnaire. Results showed a relationship among the level of instruction, the age of the participants, and the kind of conception held by them. A complex conception about instrumental teaching and learning, similar to the constructive view developed in the educational and psychological fields, appears associated to the higher grade students, whereas a realistic and direct conception appears related to the lower grade group. These results are consistent with those obtained in previous studies. Further research is needed in order to analyze the relationship between the conceptions and the actual processes and results of instrumental teaching and learning, as well as to work with the teachers in order to enrich their conceptions, which will enable more effective teaching and learning processes.

PERFORMANCE ANALYSIS II

Toward a model of performance errors: A qualitative review of Magaloff's Chopin

Sebastian Flossmann and Gerhard Widmer

Musicians at all levels of proficiency must deal with performance errors and have to find strategies for avoiding them. Performance errors have been investigated before, but most studies focus on data gathered under laboratory conditions. We present a study conducted on a unique corpus of precisely measured performances: the complete works for solo piano by Chopin, performed on stage by the Russian pianist Nikita Magaloff, recorded on a Bösendorfer SE computer-controlled grand piano in a series of public recitals in Vienna in 1989. We classify groups of errors, analyze their context and the patterns they form, and discuss probable causes.

Use of spline curve to evaluate performance proficiency of a Czerny piano piece

Asami Nonogaki, Shohei Shimazu, Norio Emura, Masanobu Miura, Seiko Akinaga, and Masuzo Yanagida

Our previous study evaluated the level of proficiency in playing the piano for only a scale of one octave. We try to evaluate the proficiency for a piano etude by Czerny, by using some conventional parameters concerning the onset, velocity, and duration, as well as those concerning a new feature, which is the tempo, obtained from the intervals of time between adjacent notes. The deviations from the standards, such as the metronome for the onset time, the velocity average, the constant length (200 or 100 ms) of a duration, and the specified tempo (75 or 150 bpm) are obtained. Then, the tendencies of the current performance are obtained from a spline curve. The representative points of the curve are determined based on "crossing" and "turning." We compared the obtained scores given by the proposed method with a simple or previous method, using the adjusted coefficients of determination between score of proficiency estimated by each method and that given by expert pianists. The scores obtained were 0.45, 0.67, and 0.69, for the simple, previous, and proposed, respectively, when playing under 75 (bpm), indicating that the proposed method can be used to evaluate the performance of piano etudes.

An examination of a MIDI wind controller for use in instrumental research

Laura A. Stambaugh

The purpose of this investigation was to determine the validity and practicality of using a MIDI wind controller in instrumental performance research. Typical methodology for wind instrument performance research includes at least one expert judge repeatedly listening to randomized performances and scoring them for pitch and rhythmic accuracy. In addition to being very time-intensive, this process is subject to human error. Because MIDI wind controllers collect digital

data, the scoring process for this data could become more accurate and faster. Specifically, this study examined correlations between 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. Additional data analysis examined breath control (dynamics) on the wind controller.

LEARNING AND TEACHING II

Lost in Eden: Guided practice for the musical tourist

John J. Picone

A myriad of factors influence a novice musician's willingness to learn to make music. How dependent is this motivation on effective practicing? What happens when, with the guidance of a music educator, musicians *practice practicing*? This research asks whether *guided practice* at an early age might prove a catalyst in the development of effective practicing which naturally occurs with musical expertise. The study explores whether developing effective learning strategies at an early age might have a significant impact on intrinsic motivation that results from greater success in addressing musical challenges. Over the course of an academic school year, 12 novice musicians participated in guided practice sessions with the researcher. Interviews with the musicians and their parents at the beginning and the end of the duration of the study, as well as video recordings of practice sessions at the musicians' homes, reveal an increase in the repertoire of practice strategies and self-regulated learning. Musicians also indicate greater self-efficacy in addressing musical challenges.

Learning to be a creative performer: Developing mixed methods to understand teachers' and students' approaches and constructs

Karen J. Wise, Mirjam James, and John Rink

This study investigates creativity in musical performance, focusing on aspects of teaching and learning within two London conservatoires. The exploratory phase reported here aims to map beliefs and practices in relation to creativity and originality, and develop appropriate methods while building collaborations with the partner institutions. The mixed-methods design had three strands, each allowing participants to shape the research agenda: (1) focus groups with teaching staff, (2) observations of one-to-one lessons of six teacher-student pairs, followed by video-recall sessions with participants, and (3) semi-structured interviews. Focusing on (1) and (2), the paper discusses some outcomes, challenges, and benefits of this approach. Different aspects of performance creativity are uncovered. Analysis of focus group data revealed two main concepts of creative development: "toolbox" (acquisition of a set of tools) and "butterfly" (emergence of a personal quality from within). Filmed one-to-one lessons and recall sessions showed examples of practice and allowed insight into creative processes as experienced by the teachers and students involved. The study takes first steps toward modeling creativity and its development in the conservatoire context. It is argued that defining adequate models of performance creativity will be made possible only through multiple methods allowing insight into complex phenomena within their social and musical contexts.

Abstracts

Thursday, 25 August 2011

Keynote paper

The art, science, and simulation of performance

Roger Kneebone

This article juxtaposes two contrasting professional domains—surgery and music—as a starting point for discussing the concept of *performance* in different settings. The paper examines possible parallels between emergency surgery and jazz improvisation as distinct yet related forms of performance, drawing selectively upon relevant literature. It then develops the concept of *simulation* as a bridge between the closed world of the operating theatre and the wider world of those who cannot access it. Presenting an accurate yet safe "transcription" of this closed world can offer an experimental setting for exploration. The article describes *Distributed Simulation*, a concept developed by the author's research group at Imperial College London. The possibilities of low-cost, portable yet highly realistic simulation extend beyond its obvious value for practicing safety-critical skills and procedures. There is clear potential for vicariously experiencing other worlds such as those of music, drama, and dance, allowing each domain to learn from others.

Thematic Sessions

SYMPOSIUM: A MAJOR COLLABORATIVE RESEARCH INITIATIVE ON SINGING: FOCUS ON PERFORMANCE

Advancing interdisciplinary research in singing: A performance perspective

Annabel J. Cohen

A major collaborative research initiative focusing on singing, entitled Advancing Interdisciplinary Research in Singing (AIRS, www.airsplace.ca), is engaging researchers worldwide in studies representing three research themes: how singing develops in every individual, how singing should be taught and used for teaching, and how singing impacts wellbeing. Over 20 studies are ongoing in nine sub-themes (i.e. three for each of the primary themes of development, education, and wellbeing). This article highlights performance aspects in the developmental theme by focusing on a test battery of singing skills that is being administered across ages and cultures by researchers in several parts of the world. The presentation also provides an overview of the performance aspects of the research enterprise as a whole, giving a context for the remaining presentations in this symposium by researchers engaged in or affiliated with the AIRS project. The project itself represents a research model applicable to studies of performance on any musical instrument. Such studies would be useful for determining unique aspects of singing performance versus unique aspects of performance on other musical instruments and for determining aspects common to performance of all musical instruments including the voice. Applications could also extend to other performance arts such as drama and dance.

Have we made ourselves clear? Singers and non-singers' perceptions of the intelligibility of sung text

Jane Ginsborg, Philip Fine, and Christopher Barlow

The intelligibility of sung text is an important component of listeners' enjoyment of vocal music and a central concern for singers and, for example, choral conductors. Expert listeners such as singers and singing teachers may be better than non-singers at perceiving sung text. We replicated and extended an earlier study investigating the intelligibility of semantically and non-semantically meaningful words performed solo and by a small group of trained soloists by carrying out an experiment in which we manipulated listening expertise, type of text, number of singers, and time of hearing. Participants listened twice to four songs with meaningful and "scrambled" lyrics, sung in unison by a choir and solo, and wrote down as many of the words as they could discern. Singers were better at the task than non-singers; more words were recorded on the second hearing and when the words were meaningful. Sung text involves distortions of consonants and vowels to which singers may be more accustomed, so that they find it easier to discern texts even when scrambled.

Choirs may be harder to understand than soloists because their phonemes are more variable and less clear. In future research we will use operatically trained soloists and polyphonic choirs.

Adults identifying as "non-singers" in childhood: Cultural, social, and pedagogical implications

Susan Knight

Singing is widely evidenced as a learned behavior, proceeding developmentally. Contrarily, the literature reveals a prevalent notion in Western culture that singing ability is governed by inherent, biological variability. This paper discusses the impact of these divergent views in a Newfoundland-based investigation of childhood-attributed adult "non-singers" (NS). It examined how participants' NS identities developed, and how such self-perception affected their lives from personal and socio-cultural perspectives. Phase I of the study comprised case-studies of nine childhood-attributed NS, including empirical measures of individual singing ability. This evidence informed a survey instrument (Phase II) administered to a wider cross-section of the public (neither pre-designated as singers nor NS) for possible wider applicability of Phase I findings. A common experiential profile emerged illuminating participants' NS identity formation. Survey data confirmed case-study findings.

Entrainment to speech and song

Pascale Lidji, Caroline Palmer, Isabelle Peretz, and Michele Morningstar

Do we entrain similarly to speech and song? English and French participants were asked to tap along with the same set of sentences, in three conditions that varied in temporal regularity and musicality. The utterances, produced by a single vocalist, were either spoken naturally, spoken regularly (aligning syllables with a metronome), or sung regularly. Participants tapped more regularly to both song and regular speech than to natural speech. One can entrain to natural stimuli that are not musical: participants tapped with similar regularity to regularly spoken and to regularly sung stimuli. However, participants' taps were better aligned with the metronome underlying song than regular speech. Although sensitivity to rhythmic regularities is not unique to music, the current findings support the idea that music, due to its rhythmic structure, is a privileged stimulus to elicit entrainment.

Perspectives on singing and performance in music therapy

Laurel Young and Jennifer J. Nicol

This article provides an overview of the potential efficacy of vocal performance as an intervention in music therapy within the context of vocal performance and associated health benefits. The authors advocate increased collaboration between music therapists and other professionals in order to develop, implement, and evaluate carefully designed performance-based singing and wellness initiatives in various contexts. Indications and contraindications for the use of performance-based singing interventions are provided. Implications for research, practice, and society are presented.

PHYSICALITY OF PERFORMANCE

Investigating the physiological demands of musical performance

Terry Clark, Patricia Holmes, and Emma Redding

An understanding of the physiological demands of music performance can be used to inform musicians' training and help prevent performance-related health problems. While the psychology of performance has been relatively well researched, little is known about the physiological demands of music performance and the relevance of fitness to musicians. This study examined the oxygen uptake during performances of a series of pieces given by skilled pianists. Five undergraduate and postgraduate piano performance students were recruited at Trinity Laban Conservatoire of Music and Dance to give informal performances totaling approximately 20 minutes. Energy expenditure while playing was assessed via measurements of heart rate (HR) and oxygen uptake. Mean oxygen uptake was 8.65 ml.kg.min while certain pieces peaked around 25.00 ml.kg.min. Mean HR was 108.95 beats per minute (bpm) with certain pieces peaking at 173 bpm. Energy expenditure in piano playing appears to be intermittent in nature, with fluctuations in intensity within each piece and differences in intensity between pieces. From this study, it appears that mean oxygen uptake during piano playing is similar to that during brisk walking.

The day-to-day workload of ballet dancers

Matthew Wyon, Emily Twitchett, Yiannis Koutedakis, and Manuela Angioi

Professional ballet dancers typically face long work days, and many complain of fatigue, particularly as a cause of injury. However, little information exists regarding the daily physiological demands of a dancer. The aims of the present study are to examine daily activity and sleep patterns of professional ballet dancers. Data regarding a single "work day" (09.30-18.30 hours) were collected from 84 ballet dancers over a three-week period to ensure that data were representational of a "typical" day. Seven dancers were from the corps de ballet, 16 were first artists, 12 were soloists, and 16 were principal dancers. Results indicated significant differences between dancer rankings for mean exercise intensity and the percentage of time spent at sedentary intensity (<3 METS), moderate intensity (3-6 METS) ($p<0.005$), and vigorous intensity (6-9 METS) ($p<0.05$). The rest versus work time were also significantly different ($p<0.001$) between rankings. It was concluded that (1) the average daily workload of professional ballet dancers varied significantly according to roles and gender and (2) the scheduled rest breaks were insufficient in length to combat fatigue, or that dancers were not utilizing their breaks to rest properly.

Psychophysiological study: Ambulatory measures of the ANS in performing artists

Paula Thomson and S. Victoria Jaque

Professional performing artists routinely manage stressful demands encountered during public performances. Fourteen professional performing artists (6 dancers, 6 opera singers, and 2 conductors) rehearsed and performed in a concert hall setting while wearing the Vivometric LifeShirt, an ambulatory instrument that measures autonomic regulation. Contrary to our hypothesis, that greater parasympathetic changes from baseline to performance would be related to higher perceived states of subjective flow during performance, we found decreased cardiac autonomic balance (CAB) and regulatory capacity (CAR) was related to dispositional and state flow in performing artists. As a group, they endorsed moderate to high dispositional and state flow as measured by two self-report instruments. This case study is the first study to investigate psychophysiological flow states during public performances. A larger sample size is needed to understand the role autonomic regulation plays in subjective flow experiences; however, the findings in this study suggest that decreased autonomic regulatory capacity is not necessarily deleterious to performance flow experiences.

CREATIVITY AND COMMUNICATION IN PERFORMANCE

Preparing for the unpredictable: Identifying successful performance strategies in human-machine improvisation

Isaac Schankler, Alexandre Francois, and Elaine Chew

We examine the human creative process involved in performing with Mimi (Multimodal Interaction in Musical Improvisation), a system designed for human-machine music improvisation on a keyboard or other MIDI instrument. Mimi makes use of a factor oracle data structure to generate new musical material based on seed material from a human performer. Used in conjunction with a MIDI interface that gives the performer operational control over Mimi and a visualization scheme that gives the performer advance notice of Mimi's actions, this system presents opportunities and challenges for the improvising musician that differ from other improvisational contexts in significant ways. This study identifies and examines some strategies for successful performance with the system, including managing interpolations, transitions, and formal design, with implications for pedagogy and for future development of human-machine improvisation systems.

Expressive performance in music: Mapping acoustic cues onto facial expressions

William Forde Thompson

The acoustic attributes conveyed in music are often ambiguous, and people vary in their sensitivity to such attributes. For this reason, expert musicians supplement performances with non-acoustic cues that support communication, including gestures and facial expressions. For musicians, facial expressions are often interpreted as emotional communication, but they reflect many other properties of music. Facial expressions provide information about phonetic information, pitch and interval size, tonality, closure, dissonance, and emotional states. How can continuous changes in facial expressions simultaneously reflect multiple dimensions of the auditory signal? In this article, I will introduce a model of music com-

munication that explains why performers map acoustic information onto facial expressions and how these mappings influence the perceptions and experiences of music listeners.

Choreographic approaches to music composition for a new musical interface: The eMic

Donna Hewitt

Gesture in performance is widely acknowledged in the literature as an important element in making a performance expressive and meaningful. The body has been shown to play an important role in the production and perception of vocal performance in particular. This paper is interested in the role of gesture in creative works that seek to extend vocal performance via technology. A creative work for vocal performer, laptop computer, and a human-computer interface called the eMic (Extended Microphone Stand Interface controller) is presented as a case study to explore the relationships between movement, voice production, and musical expression. The eMic is an interface for live vocal performance that allows the singers' gestures and interactions with a sensor based microphone stand to be captured and mapped to musical parameters. The creative work discussed in this article presents a new compositional approach for the eMic by working with movement as a starting point for the composition and thus using choreographed gesture as the basis for musical structures. By foregrounding the body and movement in the creative process, the aim is to create a more visually engaging performance where the performer is able to use more effectively the body to express their musical objectives.

PERFORMERS' HEALTH I

Can infrared thermography be a diagnostic tool for myofascial pain in wind and string instrument players

Miguel Pais Clemente, Daniela Coimbra, António Silva, Joaquim Gabriel, and João Carlos Pinho

Wind and string instrument players are exposed to repetitive hand and arm movement, with static postures and painful and tiring positions for many hours. Behavioral and psychological factors can be positively related to musculoskeletal disorders with the presence of myofascial pain, which is characterized by localized, hypersensitive spots in palpable taut bands of muscle fibers (myofascial trigger points). This article evaluates the effectiveness of infrared thermography in distinguishing asymmetries in temperatures of anatomical structures of the cranio-cervical-mandibular complex (CCMC) in musicians with myofascial pain and examines correlations with clinical complaints.

The assessment of trapezius muscle symptoms of piano players by the use of infrared thermography

Sofia Lourenço, Miguel Pais Clemente, Daniela Coimbra, António Silva, Joaquim Gabriel, and João Carlos Pinho

The aim of this study is to understand the correlation of trapezius muscle symptoms in piano players during their performance. The association of piano practice and the general health of a pianist, especially concerning the musculoskeletal system, and head posture has been studied in relation to orofacial anatomic zones and is presumed to have an influence on the biomechanical behavior of the cranio-cervico-mandibular complex (CCMC). Previous research has found that the act of playing piano involves a complex neuromuscular activity with hyperactivity of the masticatory muscles and the postural muscle trapezius. Thermal image assessment was made to the pianist's CCMC while the piano player was playing his/her piece.

Head and scapular posture in flutists: A pilot controlled study

Ziliane L. O. Teixeira, Filipa M. B. Lã, and Anabela G. Silva

Instrumental practice which requires asymmetrical postures might, in the long term, potentiate musculoskeletal disorders and lead to pain. This, in turn, may have a negative impact on musical performance quality. Thus, the assessment of postural deviations among musicians is of the outmost importance in instrumental pedagogy. This study aims to compare the head and scapular posture of flutists with different levels of expertise and a control group of singers. Results suggest that flutists have a significantly more forward head posture than singers. No significant differences were found for any other head or scapular posture measurement. Contrary to what was hypothesized, years of instrumental practice did not contribute to a more asymmetrical posture.

MOVEMENT AND EMBODIED KNOWLEDGE I

"What am I doing?" Adolescent males and their stories in dance

Zihao Li

The majority of studies on male dancers/students are either from a physical education perspective or from the perspective of established male dancers. Overall, there is an absence of in-depth scholarly study between post-primary school-age boys and pre-professional level dancers (age 13 to 18 years). This study attempts to bridge the gap. The researcher took an ethnographical approach by following more than 50 young boys with little or no dance experience for more than a year. Through numerous interviews, classroom observations, and performances, the researcher reveals the different stages that these young males experience while taking dance. The researcher also randomly selected a few artifacts that the adolescent male dance students created for their D*ancer in Me* assignment as a way to understand how and why they chose to take dance and continued to further participate in dance although they did not enjoy it at the initial stage. This article unveils adolescent male dance students' stories—their thoughts, their successes, and how they have overcome all the challenges. The active involvement in dance as shown by these high school male students is an example of how dance can become accessible and attainable to male adolescents.

Re-inventing the body image: A pilot project in a boys' secondary school

Steve Rodman

In this pilot study we looked to gather evidence on whether providing children with simple routines which enable them to become aware of the major muscles of posture can affect how they incorporate ideas about posture into their daily lives including any music practice. Our conclusions indicate this simple tuition offered in a school environment can be the precursor of a useful tool for the future. Our results could form the base for a more comprehensive longitudinal study on how and what type of physiological awareness courses can offer help and improvement in postural mal-habits for children, teenagers, and adults during every day life but also during performing.

Dances of Cape Verde: Tempo, preferences, and entrainment

Luís Xarez

Dance is a complex activity, and it gets more difficult when you have to dance with someone. The dancer must be in time with music and in time with the other or others. The entrainment concept has an important role in this case. Why do we prefer to dance with a specific dancer over another? In this study, we sought to find out who dancers prefer to dance with and the reasons for that choice. The studied variables were experience, morphological characteristics, and spontaneous motor tempo. The results indicate the importance of dance experience in preferences, a lack of influence of anthropometric characteristics in these choices, and a tendency to choose partners with a higher spontaneous motor tempo.

THE SCIENCE OF SINGING

Cochlear implant singing study

Lorna MacDonald, Talar Hopyan, and Karen Gordon

Voice and speech characteristics in deaf children vary considerably from children with normal hearing. Cochlear implant (CI) devices help improve some but not all voice quality parameters 6 to 12 months post-implantation. There remains poor long-term frequency but normal amplitude. This study explores whether vocal training in the form of singing lessons could improve speech production many years post-CI activation. Each participant, aged 13-18 years, received 10 weekly, 30-min. singing lessons at the Hospital for Sick Children. Lessons were conducted by graduates of the voice pedagogy program at the University of Toronto using a curriculum designed to initiate increased vocal effectiveness through pitch matching exercises, alignment and vocal tract shaping, breath management, and articulation of text through song learning. Singing and listening homework was directed by a practice CD produced for the study, and a practice log. Hearing aid users served as the control group. This paper details the design of the study and voice lesson curriculum, the results on the voice use of the teenagers, and indications for further collaborations between voice training (singing) and hearing impaired and cochlear-implanted students.

Intonation in solo vocal performance:
A study of semitone and whole tone tuning in undergraduate and professional sopranos

Johanna Devaney, Jonathan Wild, and Ichiro Fujinaga

This article presents a study of intonation in performances of Schubert's "Ave Maria," both *a cappella* and with accompaniment, by six undergraduate and six professional singers. The analysis focuses on the tuning of melodic semitones and whole tones and explores the impact of training and musical context on intonation, as well as whether intonation is significantly affected by the presence of accompaniment. The data from the recordings was analyzed automatically using a MIDI-audio alignment algorithm to annotate the note onsets and offsets and a fundamental frequency estimation algorithm to extract pitch-related information. Overall the singers tended more toward equal temperament except for the non-professional group's semitones, which were closer to Pythagorean tuning.

Heart versus head:
The implications of register sensation in the female characters of Mozart's *Le nozze di Figaro*

Donna Harler-Smith and Jamie Reimer

This research applies the skill of sensory perception in the teaching and performance of Mozart's female characters of *Le nozze di Figaro*. Through the physical sensation a singer experiences when phonating in the extreme head or chest registers, Mozart may be indicating intellectual and/or emotional superiority in these characters. This study is not intended to supplant conventional research about these characters, but to enhance the singer's preparation of these roles and to explore the mind-body connection that Mozart must have understood on an intuitive level.

PERFORMERS' HEALTH II

Sensorimotor alterations in violinists/violists with neck pain

Anke Steinmetz, Andrew Claus, Wolfram Seidel, Paul Hodges, and Gwendolen Jull

The aim of this research project was to determine the extent to which neck pain is present in violin/viola players and to investigate if fine motor control and dexterity are influenced by dysfunctions as such. This is important to know as impairments in dexterity are expected to have an impact on motor control in violin/viola playing and contribute to a decrease in performance excellence.

Good playing practice when drumming:
Influence of tempo on timing and preparatory movements for healthy and dystonic players

Sofia Dahl, Michael Großbach, and Eckart Altenmüller

Four professional percussionists were recorded when playing single strokes at different tempi (50, 120, 300 beats per minute [bpm]) and dynamic levels (*p*, *mf*, *f*). All players were right handed, but two of the players had their left arm affected by focal dystonia. Audio, contact time, as well as players' arm, hand, and stick movements were recorded. The analysis indicated that the healthy players use the long inter-stroke intervals available at slow tempi to prepare the strokes. Strokes at 50 bpm were, in general, initiated from a greater height and played louder than strokes at fast tempi. As expected, variability was highest for the left arm at 300 bpm.

Getting into the zone: Trait emotional intelligence predicts flow experience in piano performance

Manuela M. Marin and Joydeep Bhattacharya

The experience of flow may be one possible explanation for performers' motivation to take on intense musical practice on a daily basis. Being "in flow" or "in the zone" is defined as an extremely focused state of consciousness that occurs during intense engagement in an activity. In general, flow has been linked to peak performances and feelings of intense pleasure and happiness. In this study, flow theory and emotion are discussed in relation to personality and individual differences in musicians. We assessed flow experience in piano performance and emotional intelligence in a group of 76 piano performance students at university level using standardized tests. Multiple regression analysis revealed that flow experience can be predicted by emotional intelligence. Other background variables (gender, age, duration of musical training, and amount of practice) were not predictive. In order to predict high achievement in piano performance, a five-predictor lo-

gistic model was used to fit the data, indicating that the odds to win a prize in a piano competition increased significantly with the amount of practice, as found in earlier reports. Importantly, a positive relationship between flow and peak performance could not be supported, suggesting that superior performance in any activity is a multifaceted phenomenon that is conceptually complex and difficult to model.

MOVEMENT AND EMBODIED KNOWLEDGE II

Is it their bodies that let them down? Dancing past 35 years old

Matthew Wyon, Frances Clarke, and Victoria Thoms

Age and not being able to cope physically with the demands of performing have often been cited as the reason why dancers retire from dance. The average age of retirement still remains in the thirties for professional dancers. The aim of the present study is to examine whether there is any underlying physiological data to substantiate these claims. Seventy professional dancers undertook a number of physical fitness tests. Results indicate that age did not influence the physiological data. In conclusion it is suggested that physical fitness is not a performance-limiting factor for dancers, though it is recognized that other factors may also play a part such as age-reduced healing ability.

Studying embodied knowledge through modeling performer's evaluation parameters: A longitudinal examination of performances using distinct flute headjoints and bodies

Fernando Gualda and Leonardo Winter

Performers acquire tacit or embodied knowledge about their own playing by practicing their musical instruments. Even though this kind of expertise plays an essential role in the field of skill acquisition, it is rather difficult to create methodologies to study embodied knowledge. This study focuses on how performers evaluate their performances using different instruments. Performers' evaluations are usually qualitative and provide a brief description of a sensation about his or hers own playing. Once the instrument is changed, however, performers need to adapt to new technical requirements. Since this adaptation depends on self-evaluation, by studying how they evaluate their performances after each change of instrument, tacit knowledge may become rather more explicit through reviewing performer's remarks and comparing low-level audio descriptors estimated from analysis of audio data.

Understanding movement during performance: A recurrence quantization approach

Alexander Demos, Till Frank, and Roger Chaffin

Traditional methods of signal analysis of one-dimensional data have limited use in unraveling how the movements of a musician in performance relate to the musical structure because performers' movements are complex. Methods developed for the analysis of multi-dimensional chaotic systems, such as recurrence quantification analysis, are well suited to dealing with complex data of this type. We compared traditional and non-traditional methods of signal analysis by applying them to the movements of a musician.

Graduate Award Paper

Sustained excellence: Toward a model of factors sustaining elite performance in opera

Colleen Skull

While considerable research has explored the techniques professional athletes use to sustain performance excellence, much less research has focused on professional musicians. Multifaceted skills are needed to sustain performance excellence. This paper focuses on one dimension of the complex elite performance sustaining system: the deliberate preparation skills professional opera singers employ to maintain elite performance. Data drawn from interviews with five professional opera singers, with a minimum career length of ten years, were analyzed within the methodology of grounded theory. Results revealed a strong role for deliberate preparation in both physical and mental skills which contributed to high levels of self-efficacy, the key factor sustaining performance excellence for these participants.

Abstracts

Friday, 26 August 2011

Keynote paper

Dance pedagogy: Myth versus reality

M. Virginia Wilmerding and Donna Krasnow

The teaching of ballet is steeped in tradition. As a dancer retires from the stage, he or she will often embark upon a teaching career in order to provide a continuation of that tradition for the next generation. It is not uncommon for the institutional tenets of training dance skills to be at odds with what is biomechanically sound and, therefore, unsafe for the dancer to repeat in daily technique class. Dance science had its beginnings in the late 1960s. Colleges and universities began to turn a serious eye to the analysis of the physical component of dancing. Rudimentary equipment, such as videography, has given way to very sophisticated movement analysis systems such as 7-camera motion capture systems. As the ability to "see" dance increases with more refined tools, teachers of dance in general and ballet in particular need to make anatomically sound corrections and unassailable decisions in the training of young dancers, as the technique class should be the first stop in injury prevention. This presentation touches on just a few of the discrepancies between what is taught and what is actually possible to achieve in the ballet class.

Poster Session

Characterizing accomplished musicians' learning over time

Sarah Allen, Amy Simmons, Carla Cash, and Robert Duke

Previous research has demonstrated that learners performing repetitive movement sequences show evidence of consolidation-based performance enhancements following overnight sleep. But the effects of the organization of musicians' practice on consolidation-based gains have not been investigated. In two experiments, we examined the effects of (1) the presence of an auditory model and (2) learner-regulated practice on performance improvements during and following practice of a 13-note keyboard melody. In the first study, an auditory model of the melody was played at regular intervals throughout practice for one of the participant groups. In the second study, participants practiced the same melody in a self-regulated manner and were not constrained to the rigid practice protocols used previously in this line of research. All participants returned for a retest on the target melody following overnight sleep. We discuss our results in relation to current models of motor performance and memory formation.

Constraints on memory for verse

Kristen T. Begosh and Roger Chaffin

Participants learned limericks either while moving rhythmically or remaining still to assess how movement and characteristics of the material act as constraints on memory. During testing, they heard individual lines from the limericks (*originals*) and four types of foils that violated the meaning (*semantic violations*), rhyme scheme (*end substitutions*), rhythm (*rhythm violations*), or surface features (*internal substitutions*). They indicated whether each stimulus came from the limericks they learned and how confident they were. Participants were better able to discern semantic violations from the lines on which they were based than either the internal substitutions or rhythmic violations from their originals. Movement did not have a reliable effect on participants' ability to discriminate between originals and their corresponding foils. Participants were more confident in responses to semantic violations and originals than they were to either the rhythm violations or end substitutions. Meaning appears to be a better constraint on memory than surface features or rhythmic movements. The confidence ratings suggest the participants were aware of this difference. Movement may only act as a constraint on memory if it is instrumental in the production of the material (e.g. music and drama).

Coping with performance anxiety: Choral singing, psychological states, and cortisol

Rita Bento, Stephen Clift, and Grenville Hancox

Choral singing has several psychological, physical, and social components that can interact and contribute to feelings of wellbeing. These beneficial and positive effects of choral singing can become relevant particularly in the context of public performances. Performance anxiety is a natural reaction to public performances and an increase in cortisol has been found after a choral performance but not rehearsal. At the same time, it is possible that performance anxiety can be coped with successfully with the help of the psychosocial benefits of choral singing. This study aims to clarify contextual effects of choral singing on cortisol, to clarify the interactions between psychological states and psychophysiological measures of performance anxiety, and to clarify effects of choral singing on wellbeing. Participants recruited from the Canterbury Christ Church University's high performance choir provided physiological (saliva samples) and psychological (questionnaire) measures before and after a choral rehearsal, a choral performance, and a passive control on a different day of the week but same time of the day. The results will be presented at the conference. However, we expect cortisol levels to increase after a performance. The increase in cortisol levels will not necessarily lead to anxiety after the performance and negative affect states will rather be connected with the individual's perception of performance: if the performance is perceived as positive there will be a decrease in negative affect; if it is perceived as negative there will be an increase in negative affect.

Verbal expression of piano timbre: Multidimensional semantic space of adjectival descriptors

Michel Bernays and Caroline Traube

High-level pianists refer to and can identify nuances in timbre by way of a wide and rich vocabulary, whose abstract, imaged, and metaphoric terms acutely designate a variety of sounds. This timbre-describing lexicon is hereby studied quantitatively. The semantic proximity between pairs taken among 14 common piano timbre descriptors was evaluated in questionnaires distributed to 17 pianists. Ratings were analyzed with multidimensional scaling algorithms, yielding a four-dimensional space representing the semantic proximity between descriptors. Using cluster analyses, five main subsets were identified, within which the most familiar terms were selected. We thus obtained five descriptors which optimally describe the whole semantic space for the group of pianists taking part in this study: bright, dry, dark, round, and velvety.

"I kind of get lost in it": Experiences of learning to perform music in older adulthood

Rosie Burt-Perkins and Aaron Williamon

This study reports data collected as part of the *Rhythm for Life* project in the UK. Running from 2010-12, *Rhythm for Life* provides free programs of instrumental music lessons to adult beginners aged 50 or above. Through phenomenological interviews and analysis, the paper aims to understand the experiences of learning to play a musical instrument in older adulthood. Based on semi-structured interviews with ten adult learners, Interpretative Phenomenological Analysis (IPA) revealed four emergent themes that characterize the learners' experiences: (1) learning music as offering enhanced social interaction, (2) learning music as offering enhanced (musical) self-confidence, (3) learning music as a form of self-regulation of mood and emotion, and (4) learning music as offering scope for transcendence. This paper considers each of these themes in turn to discuss an emerging "model" of how learning to play a musical instrument in older adulthood is experienced by learners.

Music performance learning model

Daniel L. Cerqueira, Ricieri Carlini Zorzal, and Guilherme Augusto de Ávila

The present article proposes a model for music performance learning based on three root principles: motion, memory, and consciousness. Broader viewpoints are proposed, such as recognizing intuition as forms of knowledge. Sources from various scientific areas provide solid bases and dialogues, favoring better understandings of music performance and definitions of learning strategies. Implications point to the need for improved performance pedagogy within music institutions.

The art of "repetitive practicing": Torture or meditation?

Sharon A. Choa

"Repetitive practicing" is often considered to be an activity that is obsessive, mindless, and damaging, leading to many forms of repetitive strain injury. However, all practicing employs some form of repetition—it is proven scientifically to be the way to secure long-term memory in any motor activity—and in biological terms, the memory process actually alters gene expression in neurons to produce long-lasting synaptic growth. The question, therefore, is *how* and *how much* repetition should be executed to ensure that results are entirely beneficial. This article explores how extreme numbers of repetition that are often considered "torturous" might in fact be a way of attaining the highest level of artistry by consciously developing a "relaxed force" in the process of practicing. This is compared to the principles of the ancient Chinese martial-art form *Taijichuan* and can ultimately be deemed a genre of meditation. The article also poses the question of whether further neurological scientific experiments could help define the optimum number of repetitions each individual needs to suit their genetic requirements to produce the desired artistic results.

Reaching for the stars: Dance talent program at Singapore International School (Hong Kong)

Joey Chua Poh Yi

This article illustrates the framework of a dance talent program at Singapore International School (SIS) in Hong Kong. SIS was established in 1991 and serves as one of the few private schools in Hong Kong that offers a primary and secondary dance curriculum. At the time of this research, dance was offered to primary one to four students and to secondary one and two students and an ad hoc dance talent program was offered to selected primary five students. This paper raises the question: what kind of dance talent program will address the needs of the diverse communities in the school? The dance talent program framework that emerges from the research describes rationale, content, and approaches as identified by the data and research participants. Research data collected includes dance syllabi from the established Dance School of Excellence in Queensland; questionnaires and/or interviews with selected parents, students and staff at SIS and with the head of modern dance at the Hong Kong Academy of Performing Arts. It is hoped that this case study will allow the transferability of a dance talent program to other schools in the near future.

Three stages of listening during preparation and execution of a piano performance: Exchanges on the model and its application

Zélia Chueke

As a pianist, the author of this paper has previously investigated the listening activities which occur during the preparation and execution of a piano performance. Three stages of listening were established: the first involves basically inner hearing or "listening from the score," the second consists of consciously monitored practice combining inner hearing and physical hearing, and the final stage, the performance itself, gives evidence of what the performer was able to hear from the score. Reviewed literature involving musical analysis, psychology, perception, and cognition was combined with the results of interviews conducted with selected pianists of international renown, generating suggestions/guidelines for the proposed listening stages. For the present experiment, the author has worked with a graduate student in piano performance during the preparation of Brahms's *Fantasien* Op. 116, applying these guidelines as a means to optimize performance preparation. The whole process is hereby described and discussed, exploring the connection between listening parameters and the achievement of coherent execution both during preparation process and final performance.

The role and value of implementing health screening programs within music conservatoires

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

Interest in musicians' health and wellbeing is growing, reflected by increasing numbers of investigations into the physicality and psychology of music performance. Within sport and dance, screening and profiling programs have furthered understanding of not only physical and psychological capabilities and demands, but also injury mechanisms and susceptibility. Drawing on experience gained from musicians' screening conducted over a two year period, the current paper engages with questions relating to the development and delivery of musician-specific health screening programs. An effective screening program can offer a variety of benefits and provide informed recommendations for musicians' training. Employing an interdisciplinary approach when developing screening programs is essential, as is the ecological appropriateness of the measures used. At present, three types of musician-specific screening programs are currently in use at

Trinity Laban. These programs, together with implications inherent in the delivery of successful screening programs, are discussed.

Piano repertoire preparation from a praxial perspective

Regina Antunes Teixeira dos Santos and Cristina Capparelli Gerling

This study investigated the repertoire preparation of eight graduate and undergraduate piano students and revealed a variety of strategies dependent on their levels of expertise. The one or two pieces were selected from each student's program for the semester. Data were collected using semi-structured interviews followed by observations of participants' recorded performances. Most of the students (n=6) also based their practice on *praxial* knowledge, which in the present sample corresponded to very elementary means of approaching a challenging task, usually far from the ideal type of solution needed at this particular point. Within the investigated sample, the more the students were able to make connections and direct their practice based on expressive intentions, the more they were able to learn at a faster rate. Not surprisingly, then, graduate students engaged interpretive-type strategies far more often. Nevertheless, most of the students (n=6) also based their practice on *praxial* knowledge—i.e. they started out employing very elementary means of going about a challenging task. In fact, strategies based on expressive intentions and specific contexts led to productive knowledge (*poiesis*)—i.e. practical judgments about how to act in situations that involve the physical realization of one's own ideas.

A steady pace: The effects of musical expertise on tempo memory

Philip Fine and Oluseun Alufa

Remembering tempi and keeping in time are important skills in music performance, particularly for conductors, solo performers, and instrumental groups. Twelve musicians and 12 non-musicians were asked to listen to a metronome at three speeds (40, 110, and 180 beats per minute), clap with the metronome for one minute, and then clap as regularly and accurately as possible from memory later in the session and the following day. Results show that the slow speed was clapped too fast; the medium and fast speeds clapped too slowly. Musicians were significantly more regular in their clapping than non-musicians, but musical expertise did not affect memory for tempo. Medium and fast clapping were more regular on day 2 than day 1, but slow clapping was less regular on day 2. Slow and fast tempi were better remembered than medium tempi. Experts were thus no better at remembering speeds than non-musicians but were more accurate at clapping regularly.

Qigong, singing, and health: A possible composition?

Milena Flória-Santos, Carlos G. Bastos-Junior, and Maria Yuka A. Prado

This study aimed to search evidence available in literature on the effects of *qigong* as a breathing relaxation technique to reduce music performance anxiety, as well as its effects on singers' health and wellbeing. Integrative literature review was selected as the method of research. The inclusion criteria were: (1) publications in English, Spanish, and Portuguese from January 2000 to December 2010; (2) publications with abstracts available at and indexed in PubMed, Web of Science, PsycINFO, and LILACS. Twenty-two articles met the inclusion criteria. The results provided interesting tools for performers to integrate emotional, mental, and physical skills to efficiently and effectively improve their performance. Applied research through cross-disciplinary collaboration and innovative methods, such as *qigong*, may offer new possibilities to meet these challenges.

The role of cerebral resonance behavior in the control of music performance: An fMRI study

Robert Harris and Bauke M. de Jong

Mirror neurons in the cerebral cortex have been shown to fire not only during performance but also during visual and auditory observation of activity. This phenomenon is commonly called cerebral resonance behavior. This would mean that cortical motor regions would not only be activated while singing, but also while listening to music. The same should hold true for playing a music instrument. Although most individuals are able to sing along when they hear a melody, even highly skilled instrumentalists, however, are frequently unable to play by ear. They are score-dependent—i.e. they are only able to play a piece of music when they have access to the notes—while musicians who are able to play by ear and improvise are non score-dependent; they are able to play without notes. Our hypothesis is that score-dependent instrumentalists will exhibit less cerebral resonance behavior than non score-dependent musicians while listening to music.

Using fMRI to measure BOLD response, subjects listen to two-part harmony presented with headphones. The following experimental conditions are distinguished: (1) well-known vs. unknown music (2) motor imagery vs. attentive listening. A voxel-based analysis of differences between the condition-related cerebral activations is performed using Statistical Parametric Mapping.

Non score-dependency: Theory and assessment

Robert Harris, Bauke M. de Jong, and Peter van Kranenburg

Untrained listeners demonstrate implicit knowledge of syntactic patterns and principles. Untrained generative music ability, for example singing, humming, and whistling, is a largely unconscious or intuitive application of these patterns and principles. From the viewpoint of embodied cognition, listening to music should evoke an internal representation or motor image which, together with the perception of organized music, should form the basis of musical cognition. Indeed, that is what listeners demonstrate when they sing, hum, or whistle familiar and unfamiliar tunes or when they vocally or orally improvise continuations to interrupted phrases. Research on vocal improvisation using continuations sung to an interrupted musical phrase, has shown that one's cultural background influences the music generated. That should be the case for instrumentalists as well: when they play familiar or unfamiliar tunes by ear in different keys (transposition) or when they improvise variations, accompaniments, or continuations to interrupted phrases, the music they generate should reflect the same cognitive structures as their oral improvisations. This study is attempting to validate a test of (non) score-dependency that will enable assessment of the music student's implicit knowledge of these structures during performance on the principal instrument.

How expert pianists interpret scores: A hermeneutical model of learning

Charise Hastings

Many studies evaluate listeners' perceptions of performed music; fewer explore performers' perspectives on learning music. This study generalizes a model of learning from over 175 open-ended and semi-structured interviews of expert pianists. Such a model can suggest pedagogical goals to improve students' learning and factors that lead to different interpretations of the same musical score. A macro-micro-macro process of learning is described as a hermeneutic circle in which the parts and the whole inform one another simultaneously. The parts, consisting mainly of the notation in a score, can be divided into fixed, variable, and implicit qualities. Each part maintains a specific relationship to the whole: a pianist's learning of fixed qualities (pitches and rhythms) is informed by the whole; variable qualities (expressive markings) reciprocally inform and are informed by the whole; and implicit qualities (inferred structures, historical information) either inform or are informed by the whole. Expert musicians arrive at different interpretations of a score when they prioritize the whole or the parts to varying degrees. Implications for pedagogy include drawing greater attention to how the parts relate to the whole, and encouraging students to explore resources beyond the score.

Piano concerto "Yellow River": Chinese pianism in the second half of the twentieth century

Da Lin (Darren Lin), Xu Zhou, and Yuan Huang

In this paper, with various recordings of the Piano concerto "Yellow River" as the example, we focus on different styles of performance by some important Chinese pianists in the later half of the twentieth century. Yellow River, a Piano concerto based on Xian Xinghai's cantata with the same name, was composed by some prominent Chinese composers and pianists in 1969. The piece was often considered as the most famous and popular Chinese piano concerto by critics and became the favorite among many Chinese pianists. Therefore, the study on different records of such a piece from both personal interpreting and technical approaches could reflect the typical characteristics and gradual change of the pianism by Chinese pianists during second half of the twentieth century. According to our analysis on different interpretations of the Piano concerto, we found that the Chinese pianists often combined their academic background on pianism with their own personality, and even added their understanding of Chinese culture. The study indicated that, although largely affected by western cultural tradition, the Chinese pianists were always trying to find their unique interpretations on piano playing in many ways.

From traditional to constructive practices in music education: Materials with which to study conceptual change in string teachers

Guadalupe López Íñiguez and Juan Ignacio Pozo Municio

There are three essential moments during a lesson: (a) *planning* the activities, (b) *supervision* of the strategies involved, and (c) the *evaluation* of achievements. However, the ultimate aim of instrument lessons which are structured in this way is not always to give the student cause to reflect or engage in metacognitive activity. Music teachers have a variety of ideas about what and how their students learn, as do teachers from other educational fields. At conservatoires, these conceptions change depending on the relationships that are established between the teacher, the student, the score, and the instrument. In this article, we address the existence of three conceptions or *implicit theories* about instrument teaching and learning (TL) as follows: (1) *direct conception*, according to which the student has a passive and reproductive role; (2) *interpretative conception*, which assumes that the student is engaging in cognitive activity, which is subordinate to the achievement of results; and (3) *constructive conception*, in which the mental activity of the student is the main goal of learning. Starting with the implicit assumptions which are inherent in these conceptions, we created nine videos representing dilemmas (three per essential moment), in order to show the different ways in which teachers can help students to solve a tuning task, by both inferring TL conceptions and studying *conceptual change*.

Behind closed doors: Emotional abuse in the music studio

Linda J. MacArthur

An issue of concern that emerged during interviews with six adolescent elite-level classical musicians was emotional abuse from their teachers. Three of six musicians interviewed reported examples of abuse. The purpose of this paper is to discuss the topic of emotional abuse from the perspective of these three musicians. A phenomenological methodology was used in order to capture the essence of their unique "lived experiences." A thematic analysis was performed on the data, which was gathered via in-depth interviews and questionnaires. It can be concluded that: emotional abuse does indeed occur but is rarely talked about; musicians and their parents often justify abuse believing that it is "normal" or even "needed" in the quest to become the best; for some students the need to please their teacher is so strong that, despite emotional abuse, they will do anything in order to gain approval and acceptance; and confidence, a solid sense of self, and resilience are all important attributes for dealing with potential abuse and "surviving" in the world of elite-level music.

An inquiry into the function of the torso and its potential for a relationship with the music

Cristine MacKie and Iqbal Hussein

Movements of the body in piano performance have been largely discouraged by pedagogues and performers alike, according to accounts in historical treatises from 1650 onward. This is not surprising, since the ideas controlling piano pedagogy and performance have been largely allied to the structure of Western thought which nurtures a mind/body dualism. The torso is the central axis of the body, upon which the pianist depends for support, and while its function is now attracting the attention of researchers in fields such as human movement sciences, its potential for moving in synchronism with the rise and fall of the music is not.

Taste, again: Naïve listener's preferences of performed tonal music

Ângelo Martingo and Daniela Coimbra

Prior investigation by the author shows that recorded interpretations of Beethoven's *Waldstein Sonata* (2nd movement) receive higher preference ratings (e. g. expressiveness, fluency, global evaluation) by expert music listeners (1) when expressive deviations correlate to Lerdahl's theorized concepts of "tension" and/or "attraction," (2) in case of repetition, and (3) when agogics correlate to dynamics. The studies now reported replicate such investigation in naïve music listeners. The results confirm prior findings regarding preferences in cases in which expressive deviations correlate to tension and/or attraction, but not in cases in which agogics correlate to dynamics, nor regarding repetition.

Effects of meter and serial position on memory retrieval during music performance

Brian Mathias, Caroline Palmer, Peter Q. Pfordresher, and Maxwell F. Anderson

Effects of musical meter on memory retrieval in music performance were investigated. The range model, a formal model of memory retrieval in music performance, proposes that metrical similarity influences retrieval during sequence production. This assumption was tested by examining production errors in skilled pianists' performances of novel musical pieces. Pieces were practiced to a note-perfect criterion and subsequently performed at fast and medium musical tempi. The relative metrical accent strength of musical events influenced error rates. Effects of metrical accent on accuracy interacted with production rate; performance of metrically weak events was affected by tempo, but performance of the most strongly accented events was not. These findings indicate influences of higher-order event relationships on memory retrieval during production, consistent with theories of expert memory in music performance.

Schenkerian analysis as generator: Stanislavski's "given circumstances"

Bonnie McAlvin

My model of inspired performance is based on the thesis that performers can have present in mind—although not necessarily verbalized or conscious—several "graphs" or versions of the structure of a piece, among which they can toggle, unconsciously, as inspiration compels. In my model of interaction between graph and performance, the structure you hear hangs upon the underlying structure that the performer chooses to reveal, in that notes that are subservient in a graph enter into specific relationship with the structure they immediately embellish. By using tools such as volume, color, vibrato, and tempo, a player can encourage an understanding of function for each pitch and pitch event, resulting in a hierarchy of pitch relationships that extends from the surface all the way into the deep structure of a performance. The struggles a graph faces, both within itself and within a larger network of relevant motivations such as meter, melodic contour, surface harmony, and instrumental limitations can serve to provide "given circumstances" in the manner of Constantine Stanislavski. Exploration of potential structures and their consequences can guide a performer toward mental construction of a "network of structural potentialities," which can be travelled, via portals, in and among various graphs.

Pansonic coordination on the drum set:
The synthesis of the essential components in groove-based improvisation

Augusto Monk

Due to the development of the instrument over the last three decades, drummers have gained access to a wider range of functions within the music making ensemble. One of the most innovative areas in the expansion of the drumset has been *pansonic coordination* created by Kenwood Dennard in the mid 1970s. This approach to drumming consists of adding other sound sources to the drum set such as keyboards and pedal boards in order to realize harmonic and bass-line functions along with the drumming. Since the drummer performs two, three, or four instruments simultaneously, pansonic coordination is possible when each texture is synthesized to its essential components. This poster presentation introduces the principles of pansonic coordination and illustrates some of its applications in groove-based, improvised performance. Drawing from notions of cognitive science, the poster also shows a pedagogical approach to learning this multi-instrumental technique.

Performance implications of instructional material in instrumental music education: A case study

Efthymios Papatzikis

This paper discusses the impact of teaching on instrumental music performance as seen and shaped through a piece of instructional material. A part of Ševčík's violin methodology is analyzed, using an established framework of teaching models. Findings show that there is an active imprint of teaching models inherent in the particular violin methodology, suggesting in conclusion that instructional material could play an active role in shaping cognitive performance practice, as it could dynamically affect students' and teachers' learning and teaching aspects according to its instructional dispositions and balances.

The effects of music tuition on academic achievement in Portuguese 8th year students

Carlos Santos-Luiz, Daniela Coimbra, and Cláudia Andrade

The positive association between music lessons and academic achievement is well documented in the literature. Students who learn music show better academic achievements than those who are not involved in musical activities. However, this is a multifaceted association that can only be explained if several dimensions are taken into account, such as socioeconomic status (SES) or general intelligence (*g*). Significant differences in academic achievement were found between 8th year students who studied music (n=60) and those who did not (n=50) in five out of seven subjects analysed: natural sciences, physics and chemistry, Portuguese language, history, and geography. In addition, a multiple linear regression analysis was conducted in order to assess the role played by other potential dimensions (SES and general intelligence) in academic achievement. After including SES in the analysis, the results indicated that music tuition still contributed significantly to the given variance in academic achievement. However, in combination with all the factors (music tuition, SES, and general intelligence), music learning lost its statistical significance. Moreover, contrary to the majority of studies, one noteworthy finding was that SES had no significant impact on academic achievement. In conclusion, the results suggest that musical tuition does have a positive relationship to academic achievement.

Repetition and judgment of learning in wind instrument practice

Laura A. Stambaugh

This study draws on two existing lines of research: blocked and random practice orders and judgment of learning. University wind and brass students practiced three short technical tasks in either a repetitive order or a random order during two practice sessions. Retention testing occurred 24 hours and 1 week after the second practice session. Performances were evaluated for accuracy, speed, and evenness. Woodwind players benefited from a random practice order. A secondary research question was drawn from judgment of learning research in motor learning and metacognition. At the end of the second practice session, participants predicted the metronome marking at which they would play each music task. Predictions were compared with the actual tempos performed at 24-hour retention. All instruments had low to moderate correlations between predicted and performed tempos.

The musician doctor: A musical evaluation of treatments for movement disorders

Floris T. van Vugt, Thomas D. Hälbig, Michael Schüpbach, Franziska Buttkus, and Eckart Altenmüller

Various therapeutic approaches have been established for the treatment of movement disorders such as Parkinson's disease, dystonia, or essential tremor. However, the effects of such therapies on fine, more sophisticated motor movements relevant to musicians are not well known. The aim of this study was to develop a reliable tool that would allow assessment of treatment effects on fine motor movements through measures of musical performance. The playing of a professional violinist suffering from Parkinson's disease was recorded during different treatment conditions. In each recording, a scale and two themes from violin concertos were played. These were presented (audio only) to 11 violin students who, unaware of the medical history of the player, rated the extracts along various musical dimensions (e.g. intonation, timing, and emotion). We thus employed the highly trained musician's ear to detect fine differences of various treatments on instrumental playing. The ratings allowed striking differentiation between the different treatment conditions. Our study provides an innovative way of evaluating the impact of movement disorders and of different treatment modalities on sophisticated motor functions. Our paradigm can readily be extended to other movement disorders, as well as to other instruments.

Tuning movement: Body education in teaching music instruments

Flora M. G. Vezzá and Isabel M. T. B. Pereira

Performance related musculoskeletal disorders are highly prevalent among instrumentalists and have led to an increase in health, wellbeing, and prevention actions in countries around the world. Researchers on prevention of occupational musculoskeletal disorders propose that an effective way of reducing their prevalence and gravity is to intervene during training periods, using professional know how of more experienced workers—the *savoirs de métier/savoirs de prudence*—that allows them to keep safe. Learning a musical instrument involves not only the acquisition of very complex motor skills and language symbols but also represents the initiation to a social group with very structured mores and rules of conduct that may interfere with health behaviors. This article presents ongoing research that investigates the

training of beginners and intermediate students at a public music school in São Paulo, Brazil, particularly regarding the way teachers approach the body and movement. Preliminary results indicate that teachers' verbal abilities for describing sound, movement, and sensation can be described as part of the *savoirs de métier* that interfere with students easiness of learning and performing. This could be used in health promotion contexts on the activity of performing an instrument.

A comparison of music performance anxiety to a laboratory stressor

David Wasley, Aaron Williamon, and Adrian Taylor

This study extends previous work investigating the cardiovascular reactivity to stress obtained in response to laboratory-based tasks to cardiovascular reactivity measured in response to a musical performance. Heart rate (HR) reactivity and psychological responses were measured in 52 female and 18 male healthy classically trained graduate students in two settings: during a standardized laboratory stressor (Stroop) and prior to a jury assessed musical performance of two pieces. HR and state anxiety (SAI) were assessed. Results indicate that while both conditions increased HR significantly, there was no difference in the magnitude of change in response to the musical performance and the laboratory stressors. However, the musical performance produced significantly higher levels of perceived anxiety between conditions. A greater correlation was observed for HR in between conditions compared with the relationship observed in the SAI responses. Some support is provided for the view that the Stroop could be used to identify higher HR responders to musical performance, although its efficacy to self perceptions of anxiety are less compelling.

John Dewey and F. M. Alexander: Habit and performance skills

Malcolm Williamson

In a PhD thesis by McCormack, *John Dewey and F. Matthias Alexander: A Neglected Influence*, Alexander is identified as a significant influence on Dewey's philosophical thought. The 25-year association is re-examined in the light of what the two men say about the nature of habit, and its relevance to performing artists and skill development.

Investigating time relations in musical instrument's masterclasses

Ricieri Carlini Zorzal, Daniel L. Cerqueira, and Guilherme Augusto de Ávila

Even though musical instrument's individual classes in conservatoires and schools of music have been investigated by many authors, there is still demand for specific studies regarding the unique characteristics of masterclasses. The present work analyzes two of these characteristics: masterclass durations and the time spent by both professor and student in the context of music festivals. One hundred and thirty masterclasses that took place in Brazil and Portugal were analyzed by the researchers. All masterclasses had their durations measured according to the following parameters: total duration, student speaking time, student performance, instructor speaking time, and instructor performance. The average masterclass duration was 34 min 37 s, with a standard deviation (SD) of 26 min 46 s. This high variability seems to be related to the challenges of predicting the duration of a masterclass, which depends on a multitude of factors, such as the instructor's individual teaching strategies, time limits defined by festival organization, and the student's performance level. Time spent between student and instructor shows that masterclasses often do not focus on verbal dialogue. A longitudinal study becomes necessary to investigate if there is musical learning in fact or just the momentary reproduction of interpretative ideas suggested by the instructor.

Thematic Sessions

SYMPOSIUM: EMPIRICAL APPROACHES TO THE STUDY OF EXPRESSIVE STRATEGIES AND AESTHETIC RESPONSES IN HARPSICHORD PERFORMANCE

Disentangling performer- and piece-specific influences on interpretative choices: A comparison across three harpsichord pieces

Bruno Gingras, Pierre-Yves Asselin, and Stephen McAdams

This study aims to identify the markers of artistic individuality in music performance by discriminating between piece-specific stylistic influences and commonalities in performers' expressive patterns across pieces, using a robust statistical approach. Twelve professional harpsichordists from the Montreal area recorded three pieces on a harpsichord equipped with a MIDI console. Each piece was recorded at least twice. Performances were matched to the scores of the pieces using an algorithm developed by the authors. Four expressive parameters were analyzed: velocity, note onset asynchrony, timing deviations, and articulation. Analyses of variance using linear mixed models were used to estimate effects related to individual performers and specific pieces. Mantel correlograms, which allow comparisons between two similarity matrices, were used to compare expressive strategies on a note-by-note basis across pieces. Comparisons across pieces revealed significant differences in the amount of overlap and velocity employed for specific pieces. Some performers consistently deviated from the mean values for specific expressive parameters, indicating that some broad markers of artistic individuality may transcend pieces and genres. Correlational analyses revealed unexpected dissimilarities between pieces in the performers' note-by-note expressive profiles. Musicological considerations and stylistic issues are advanced to explain these observations.

Exploring interrelationships between melodic expectations, tempo variations, and perceived tension in performances of an unmeasured prelude for harpsichord

Bruno Gingras, Meghan Goodchild, Roger T. Dean, Marcus Pearce, Geraint Wiggins, and Stephen McAdams

Studies comparing the influences of different performances of a piece on the listeners' aesthetic responses are constrained by the fact that, in most pieces, the metrical and formal structure provided by the score limits the performer's interpretative freedom. As a semi-improvisatory genre which does not specify a rigid metrical structure, the unmeasured prelude provides an ideal repertoire for investigating the links between musical structure, expressive strategies in performance, and listener's responses. Twelve professional harpsichordists recorded two interpretations of the *Prélude non mesuré No. 7* by Louis Couperin on a harpsichord equipped with a MIDI console. The MIDI data were analyzed using a score-performance matching algorithm. Subsequently, 20 non-musicians, 20 musicians, and 10 harpsichordists listened to these performances and rated the perceived tension in a continuous manner using a slider. Melodic expectation was assessed using a probabilistic model (IDyOM) whose expectations have been shown to match closely those of human listeners in previous research. Time series analysis techniques were used to investigate predictive relationships between melodic expectations and the performance and perceptual parameters. Results show that, in a semi-improvisatory genre such as the unmeasured prelude, predictability of expectation based on melodic structure has a measurable influence on local tempo variations.

Perceiving individuality in musical performance: Recognizing harpsichordists playing different pieces

Réka Koren and Bruno Gingras

The present study aimed to test whether listeners are able to distinguish between unfamiliar performers playing two different, unfamiliar pieces on the harpsichord. Recordings of two different Baroque pieces by six professional harpsichordists were used in this test. Twenty musicians and twenty non-musicians, with ten men and ten women in each group, participated in the experiment. Most of the participants performed significantly better than chance, demonstrating that there was sufficient information in the excerpts to recognize the performance characteristics of any given performer. The grouping accuracy of musicians was significantly higher than that of non-musicians. Moreover, grouping accuracy was significantly different between both pieces, suggesting that their features differed in a way which rendered one of them more easily recognizable.

PERSPECTIVES ON PERFORMANCE

The problem with performing

Anthony Gritten

It is acknowledged that words have effects and affects as well as meanings, and that things happen when certain words and rhetorical structures are chosen and others are rejected. How scholars theorize performing is a matter as much of the words employed to phrase ideas as of the ideas "themselves." One such configuration is the rhetoric of "performing as problem solving." This article analyses a key performance studies text with regard to the way in which the theory of per-

forming exhibited in it invokes and involves the rhetoric as a means of articulating the relationship between practicing and performing.

The British clarinet school: Legacy and legend

Colin Lawson

At the beginning of the twenty-first century, music surrounds us on a daily basis. Instant access to recordings and immediate comparisons of performances worldwide have become an integral part of our lives. Yet arguably there has been a heavy price to pay. In Mozart's day, major European cities such as Vienna and Prague boasted distinctive musical personalities; nowadays, even such a hitherto distinctive ensemble as the Czech Philharmonic Orchestra has assumed an international aura, with a less identifiable corporate sound. Opportunities provided by air travel have further encouraged such a process. Early recordings provide valuable evidence of what has been lost in terms of individuality and national styles, and these have increasingly been the subject of detailed research. A useful case study is provided by the British Clarinet School. "The Clarinet has long been considered by the whole Musical Profession as the most beautiful of wind instruments," remarked the great English clarinetist Thomas Willman in 1826 (p. 1). "That king of the reed instruments, the clarinet…," wrote his successor Henry Lazarus in 1881 (preface, p. 1). Since 1900 or so there has been aural evidence for these assertions. As one of Mozart's contemporaries put it, some musical subtleties cannot really be described—they must be heard.

Breaking traditions: Art song theatre cognitive shifts through staged modalities

Rena Sharon, Eric Vatikiotis-Bateson, Tom Scholte, Gayle Shay, David Walsh, and Adriano Barbosa

Art Song is an intricate fusion of poetry and music, a text/tone symbiosis capable of activating synaesthetic cognition and powerful states of emotional, visceral, and ideational perception. The coalescence offers fascinating cross-modal insights into the dialectical codes of composers, suggesting a philosophical journal and a personal lexicon of auditory gestures. In theory, its exceptional specificities make Art Song a uniquely approachable genre within the abstract realm of Western classical music. So, why aren't audiences packing concert halls? Paradoxically, surveys indicate that a majority of audiences report experiences of disengaged alienation. The burgeoning popularity of contemporary opera, using comparable vocal techniques within dramatic environments of converging multimedia stimuli, presents a daunting challenge to the recital's minimalist stagecraft. If creative innovation would ameliorate Art Song's reception, its common practice enjoins proscribed expressive parameters that are intractable to alteration despite a proliferation of evidence that its domain as performance art is at risk. Addressing the sources of disconnection, this project explores experimental and controversial theatre practices in pedagogical and production environments. A cohort of adjunct empirical research measures multimodal shifts in performative outcomes. Breathing, vocal production, speech flow, physical expressivity, and phrasing are all demonstrably impacted, with immediate concomitant perceptual shifts of comprehension for audiences.

EVALUATING PERFORMANCE

Investigating critical practice

Elena Alessandri, Hubert Eiholzer, Alessandro Cervino, Olivier Senn, and Aaron Williamon

This article offers a preliminary overview of a large-scale study of 845 reviews of commercial recordings of Beethoven's 32 piano sonatas published in *The Gramophone* between 1923 and 2010. Data regarding publication date, repertoire reviewed, pianist(s) reviewed, music critic, label, release status, and length of the text were extracted and analysed. The results highlight that, despite the high number of critics (n=59), labels (n=136), and pianists (n=216) involved, a large proportion of reviews were written by relatively few critics (n=7) of recordings released by few labels (n=8) and of performances given by few pianists (n=17). The analyses showed that labels and pianists who produced more recordings received longer reviews. Two of the seven most prolific critics seem to have been given more freedom to write idiosyncratically, with particularly long and short reviews. In a second phase, a pilot text content analysis was carried out on a subset of 63 reviews. Results reflect an increasing focus on interpretative issues over the course of the century, with later reviews providing more text on interpretation. This is in line with the growing quantity of reviews of reissues (from the 1950s) and releases of old recordings (from the 1980s) found in the full dataset.

Piano performance assessment: Video feedback and the Quality Assessment in Music Performance Inventory (QAMPI)

Megumi Masaki, Peter Hechler, Shannon Gadbois, and George Waddell

This study assesses the validity of a new self-report measure of piano performance quality, the *Quality Assessment in Music Performance Inventory* (QAMPI), and the adaptability of sport video analysis methods to piano performance evaluation. Piano students from Brandon University's School of Music (n=21) volunteered to have real rehearsal and concert performances video recorded. Students employed QAMPI before and while watching the video recording to assess the perceived quality of their concert performance compared with their individual performance potential established in the rehearsal. An expert also employed QAMPI to evaluate each student's concert piano performance quality after reviewing the rehearsal and concert video recordings. Initial results indicate that piano students' assessment of their performance quality measured by QAMPI before and while watching the video recording differ substantially and that the students' self-evaluation while watching the performance video recording is closer to that of expert assessment. Cronbach's alpha demonstrated good internal consistency. These initial results indicate that QAMPI provides a consistent measure of music performance elements using video feedback and insight into pianists' self-perception of performance quality.

An evaluation of parameters in performance: The effects of aural and visual stimuli

Cristina Capparelli Gerling and Regina Antunes Teixeira dos Santos

The performance of the Brazilian composer C. Guarnieri's *Ponteio 22*, interpreted and evaluated by undergraduate and graduate piano students (n=15), was monitored over 16 weeks. Each participant evaluated audio-only and audio-visual modalities for nine musical parameters: articulation, tempo, timing, dynamics, texture, phrase contour, accuracy, character, and global coherence. A strong correlation was found between the pre-arranged parameters of phrase contour and global coherence in the audio mode, while in the audio-visual case, the strongest correlation occurred between the parameters of timing and global coherence. Data were analyzed by statistical multidimensional scaling. Data have shown that the nature of the stimuli affects the relationships among dynamics, accuracy, articulation, and tempo. The synchrony between audio and video seems to interfere with perception and evaluation by students in this sample.

SOLO AND ENSEMBLE EXPERTISE

A self-study of practice: Words versus action in music problem solving

Tânia Lisboa, Roger Chaffin, and Topher Logan

This study explores the strategies, thoughts, and artistic behaviors involved in learning a new piece for memorized performance. It discusses how an experienced cellist (the first author) prepared the *Prelude* from Bach's Suite No. 6 for cello solo, BWV 1012, for performance. The paper describes her experience and insights as a musician studying her own practice in collaboration with psychologists. This longitudinal case study took place over a period of 3.5 years during which the entire process of learning, memorizing, and giving ten public performances of the Prelude was recorded and analyzed. The results highlight the contrasts between thoughts (articulated in words) and actions (demonstrated through playing). Although a large number of comments were on technique, practice was shaped by general musical understanding, from very early stages of learning. Expert music learning can, therefore, be compared to theories of expert problem solving: identifying underlying principles, developing a deeper understanding of the issues before proceeding, taking steps toward solving the problem guided by a big picture. This is in line with Neuhaus' suggestion that a musician's first goal in approaching a new piece should be to develop an "artistic image" of its musical shape.

Ensemble performance: The sum of performers?

Jan Tro

This paper presents measurements of timing and dynamic variation and deviation in musical passages, and similarities/differences among repeated musical parts.

Workshops

Understanding vocal performance: Excavating and exhibiting life's voice

Lorna MacDonald

Recognized as one of the first and final signs of life and identification, the human voice mirrors age, health, gender, well-being, emotions, culture, and art. For those educators and performers devoted to musical expression through singing, our teaching tasks are multi-layered, sequential, and highly interpersonal. Discovering the vocal personality of each singer and the inherent texture of the vocal instrument begins the process. Coordinating the mind and body organizes and frames the instrument, while provoking the singer's musical and dramatic imagination frees it for public display. From childhood throughout old age, the voice speaks for our minds and sings for our hearts. This workshop provides tools of excavation for singing at a variety of stages and ages through demonstration, discussion, and performance. Voice sampling of childhood, adolescence, young adult, professional, and late adult singing is included, and attendee participation is encouraged.

Dynamic artistry: Unlocking sound potential

Midori Koga and Jessica Johnson

We have the great fortune to work with sound in all of its many shades and colors. Yet, it is only when the core of the tone emanates from a dynamic body in balance that the sound begins to resonate in our ears and bodies. Playing the piano is a physical endeavor that requires total mind/body/ear coordination for optimal performance. Much like athletes, pianists undergo hours of training to improve efficiency, speed, and agility, all to serve an artistic goal. Drawing from our experience as performers, teachers, and researchers—as well as the latest scientific research in biomechanics and arts medicine—this workshop explores how optimal body alignment and an increased awareness of cycles of activity and rest while playing may reduce the risk of playing-related pain and musculoskeletal disorders in pianists and, most importantly, lead to heightened musical freedom and expressivity. Using aural, kinesthetic, and visual cues through the use of biofeedback from the ProForma Vision sEMG system and the Nintendo Wii Balance Board, we demonstrate how the art of dynamic balancing can help us unlock our core sound and artistic potential in a healthful, vital way.

Abstracts

Saturday, 27 August 2011

Thematic Sessions

SYMPOSIUM: MULTIMODAL MODELS OF MUSIC PERFORMANCE

When vocal training masks structure: Individual differences in visual aspects of sung interval size

Frank Russo, Lisa Chan, and Darryl Edwards

Vocal training typically emphasizes aspects of production that are important to pitch and voice quality such as vocal control and breathing. By contrast, visually available aspects of production tend to receive far less attention. Nonetheless, recent research suggests that visual aspects of performance are relevant to audience experience, influencing perception of emotion and structure. With regard to the latter, a linear relation has been demonstrated between the size of sung melodic intervals and the extent of head movement, eyebrow lifting, and mouth opening. Observers track these visually available aspects of song production, and they influence judgments of interval size in a manner that is pre-attentive and automatic. We wondered whether the emphasis on vocal control in classical training might somehow interfere with visual aspects of performance. We asked classically trained and competent amateur vocalists to produce ascending melodic intervals ranging in size from unison to octave. Participants were asked to make estimates of interval size based on observation of visual-only recordings. Accuracy of estimates was higher for intervals that were produced by the untrained group. This provocative finding may have implications for vocal pedagogy.

Poor-pitch singing as an inverse model deficit: Imitation and estimation

Peter Q. Pfordresher

Research on the phenomenon of poor-pitch singing is puzzling in that most of the evidence to date has ruled out rather than supported possible sources of the deficit, including pitch perception ability, motor control, and memory capacity. I propose a new way to conceptualize deficits of singing rooted in motor control research. That is, poor-pitch singing may reflect a vocal-specific deficit of inverse modeling, the ability to plan motor gestures based on an intended output.

Facial expressions in vocal performance: Visual communication of emotion

Steven R. Livingstone, Caroline Palmer, Marcelo M. Wanderley, William Forde Thompson, and Jennifer Lissemore

This study investigated observers' emotional responses to facial expressions during song and speech. Silent presentations of facial expressions from neutral, happy, and sad song and speech productions were divided into three regions: prior to vocal onset, during vocal production, and following vocal offset. Observers were highly accurate and confident at identifying emotion during and following vocal production, but were less accurate for the region prior to vocal onset. Emotionally neutral presentations were identified less accurately and confidently than happy and sad presentations in all regions. Producers are known to exhibit decreased facial movement prior to vocal onset and for emotionally neutral utterances. These findings indicate that facial expressions may be important for the perception of emotion during vocal communication.

Sensorimotor integration in solo and duet performance

Caroline Palmer and Janeen D. Loehr

Performing ensemble musicians must isolate and integrate the auditory consequences of their actions with those of others. We compare solo and duet piano performance in terms of the influences of structural relationships between musical parts and individual differences between ensemble performers. The same pianists performed novel two-part musical compositions that varied in the structural complexity of the rhythmic and harmonic relationships between the parts, in both solo and duet performance conditions. The structure of the left-hand part was designed to be "simple" or "complex" in its melodic contour and in the required hand and finger movements, while the right-hand melody remained the same. Tempo and synchronization measures between parts indicated that duet performance reflected adjustments by both performers while retaining some influence of their individual tempo preferences. The difficulty of the structurally complex part resulted in a slower performance tempo, in both duet performance and in solo performance. The timing of each part

showed adaptation by each performer to tempo changes in the other performer's part. These findings suggest a closed-loop model of successful ensemble performance in which motor actions result from a combination of planning for anticipated outcomes, combined with fast adaptation to sensory events produced by others.

Visual and auditory cues in jazz musicians' ensemble performance

Michael F. Schober and Michelle F. Levine

When musicians perform together live in the same physical space, they rely on a range of auditory and visual cues in order to coordinate as an ensemble. The available cues vary depending on the instruments and musical genre (and thus the motoric and auditory information each performer displays) and the physical arrangement of the performers. For example, different sightlines of the other performers affect the extent to which those performers' bodily and gaze signals—as well as movements that provide useful information even if they are not intended communicatively—are available to aid coordination. Despite musicians' lore, little work has empirically investigated the extensive multimodal integration required to coordinate in an ensemble. The aim of this paper is to lay out a basis for empirically studying ensemble coordination, by outlining the known and proposed visual, auditory, and motoric cues that performers display (as intentional signals or not) and that can be used by ensemble partners for coordinating. Along the way, illustrative results of analyses of our corpus of performances of the same piece by 30 pairs of jazz pianists and saxophonists in three modes (face to face, via remote video, and via remote audio) are used to demonstrate the utility of this scheme. The paper's main contribution is to demonstrate that musicians' use of coordination cues is more complex and multifaceted than one might at first think. Musicians in ensembles are faced with multiple competing cognitive demands for planning and executing their own performances while monitoring their partners; our evidence suggests that different cues are useful at different moments during a musical piece. So, for example, visual information from one's partner does not appear to be particularly useful during an ongoing rhythm, and can even be distracting and harmful for a saxophonist during an improvised solo, but it is enormously useful for successfully producing a simultaneous attack that is not during an ongoing rhythm. Different musicians also appear to vary substantially in their reported and demonstrable need for visual cues and physical co-presence, suggesting that more complex models that include individual variability in cue use are likely to be needed. A more solid empirical basis for understanding how musicians of different performance skills and proclivities, in different genres and ensemble sizes and physical arrangements, will allow a fuller science of musical coordination, as well as a deeper understanding of how musicians integrate multimodal information—their own and their ensemble partners'—in performance. Understanding which cues are useful for which kinds of coordination can potentially inform pedagogy for musical collaboration.

Two comparative case studies of facial gesture and bodily expression in contemporary interpretations of *Liebestraum* by Franz Liszt

Jane W. Davidson and Sharon Chung

This paper investigates how facial expressions/gestures map against structural features and/or narrative and non-narrative meaning in music being performed and how these relate to overall bodily movements. Recordings of live performances of Liszt's piano *Nocturne No. 3 in A-flat Major* by Lang Lang and Evgeny Kissin provide the data for analysis. Comparative analyses reveal: (1) a high degree of congruence in the overall style and content of overall expressive body movements (e.g. body sway) and facial expressions (e.g. smiling with eyes closed and eyebrows raised); (2) very different bodily and facial expressions employed by each performer; (3) specifically identifiable gestures manifest and intensified at moments of musical structural significance (e.g. climatic cadence points) and high consistency in the locations of gestures between performers; (4) facial gestures that can be mapped against existing classifications (e.g. Ekman). In Kissin's case, many of the gestures employed simultaneously generate/reflect physical tensions (e.g. held breath). For Lang Lang, explicit erotic imagery is contained in facial and physical expressions (e.g. open mouth, head thrown back, surging swaying movement). The expressions generated have a communicative association with the title's "Dream of love," the gestures communicating explicit images of passion and eroticism in an individualized manner.

THE SCIENCE OF PIANO PLAYING

Protecting the pianist's hand: The *carrezando* touch and more

Cristine MacKie

There is a high incidence of non-structural musculoskeletal problems and pain among pianists. This is not surprising, since pianists in general focus on developing their finger strength and independence, one from another, by adopting high, moderate, or small tapping movements of the fingers to depress the note to the key bed. The fingers are subjected to an enormous number of repetitions in this way throughout the lifetime of the pianist, who often fails to give due consideration to the function of the hand. There is an alternative approach to the development of the hand which may be traced back to J. S. Bach and includes advocates such as Deppe and Chopin, but since then has been largely forgotten. It is called the *carrezando,* or caressing, touch. This is the natural prehensile function of the hand and maybe performed by individual or groups of fingers and the opposable thumb, as in scales or chord playing. In this article, I discuss the efficacy of developing such an approach over the more traditional finger training.

Exploring real-time sonic adjustments in the performance of notated music: Morton Feldman, space acoustics, and the variable timbres of piano sound

Victoria Tzotzkova

In an essay titled "Coping with pianos," Alfred Brendel assures us that "anyone who has ever travelled with a piano knows that the same [instrument] not only sounds different in different halls, it even seems to feel different in its mechanism…" (p. 336) Even more strikingly, this difference in the feel of the instrument manifests itself in the same space and on the same day between the afternoon rehearsal and the evening performance. On Brendel's account, the acoustic difference the presence of an audience makes figures into the performance experience of the pianist in significant ways, impacting even the experience of an intimately familiar instrument. The present research focuses on the role of listening in acts of performance, aiming to open to investigation the ways that pianists may adjust their actions in performance in order to obtain a desired sort of sound under particular acoustic circumstances. It further aims to complicate the idea of timbre in piano performance, seeking to move away from a conception of timbre as an aspect of sound given solely by the instrument and move towards a conception of timbre as a given range of possibilities available to the pianist.

PERFORMANCE ANXIETY

Electrophysiological markers and pianists' anxiety: A preliminary study

Filipa M. B. Lã, Helena Marinho, Anabela Pereira, and Isabel M. Santos

Subjective measures of music performance anxiety have been commonly applied to assess the impact of relaxation techniques and cognitive behavioural therapy as coping strategies. This pilot study attempts to assess the impact of a stress-management programme (SMP) in the management of performance anxiety levels of piano students playing at public concerts. A descriptive longitudinal controlled study was carried out comparing two groups of music students: pianists who undertook 10 sessions of SMP (the experimental group); music students who did not undergo these sessions (the control group, with 1 guitarist and 1 singer). For both groups, subjective and objective measures of assessment were carried out. A self-report questionnaire and measures of brain activity and physiological arousal—electroencephalogram (EEG) and electrodermal activity (EDA), respectively—were undertaken 30 minutes before public performance. This was done twice for both groups: before the SMP (baseline) and 12 weeks after. Results suggest mild effects of SMP on objective measures. Inconclusive results regarding subjective measures suggest the necessity for developing future protocols applying both subjective and objective measures of music performance anxiety on larger-sized sample groups.

An investigation into the acute effect of exercise on physiological and psychological responses to musical performance

David Wasley, Aaron Williamon, and Adrian Taylor

Musicians experience anxiety and stress as an occupational hazard. Various approaches are available to the individual that may mitigate perceptions of excessive anxiety. Acute exercise (EX) has been shown to reduce the level of psychological and physiological response to laboratory stressors, although its impact on music performance anxiety (MPA) is less clear. Twelve classically trained musicians completed a baseline familiarization session, with 20 minutes of EX and quiet

rest (NEX) in a counterbalanced order prior to a performance, videoed as part of a performance competition. Cardiovascular measures (heart rate [HR], heart rate variability [HRV], and blood pressure) were collected at baseline, pre-, during, and post-performance. Anxiety and self-reflective performance ratings were collected pre- and post-performance. EX reduced HR reactivity significantly during and post-performance, but not prior to performance. HRV showed signs of vagus withdrawal during and post-performance in EX. Blood pressure changes and anxiety were not significantly different between conditions, nor were reflective appraisals with the exception of "importance of winning the competition," which was lower in EX. Acute exercise appears to alter cardiovascular responses to a musical performance, although not how individuals perceive anxiety.

The effect of virtual training on music performance anxiety

Josiane Bissonnette, Francis Dubé, Martin D. Provencher, and Maria Teresa Moreno Sala

This study investigated the effects of virtual reality training on music performance anxiety. Seventeen music students were randomly assigned to a control group (n=8) or a virtual training group (n=9). Participants were asked to play a musical piece by memory in two recitals at three weeks interval. The anxiety was then measured with the Personal Report of Confidence as a Performer (PRCP), the S-anxiety scale of the State-Trait Anxiety Inventory (STAI-Y), the Subjective Units of Distress scale (SUDS), and by pulse rate. The virtual training consisted of six one-hour long sessions of virtual exposure. Results indicate a significant decrease in performance anxiety (PRCP) for women in the treatment group and a significant decrease of State Anxiety (S-anxiety scale) for musicians with high levels of trait anxiety (T-anxiety scale) in the treatment group.

THE SCIENCE OF DRUMMING

"Play in time, but don't play time": Analyzing timing profiles in drum performances

Lorenz Kilchenmann and Olivier Senn

This paper investigates how professional drummers intentionally vary the micro-timing of their playing. Performances of two drummers, playing a simple rhythmic pattern in different "feels" (phrasing styles), were recorded. The onset times of all rhythmic events were measured with computer-aided methods, and the timing data were analyzed. Each "feel" shows particular timing patterns. In addition, the micro-rhythmic fingerprints of the two drummers are identifiable.

Estimating musical score of drum performance based on the Bayesian method

Yuki Konishi and Masanobu Miura

We designed a system that estimates the musical score of a player's performance based on the MAP estimation. The proposed method matches the inputted performance to a drum pattern in the database of 12,395 patterns. After matching, onset deviation from drum patterns in the database is calculated as the adaptation probability of the inputted performance. A posterior probability of each pattern in the database is then calculated by multiplying the adaptation probability by a prior probability, where the database is used to obtain the prior probability from the occurrence frequency of each pattern. The pattern with the highest prior probability is used as the estimated musical score. Experimental results showed that an averaged F-measure of 0.88 was obtained, indicating that the proposed method is an effective means of estimating musical scores.

Use of relationship between characteristics of rebound and surface EMG of arms to measure physiological load during drum performance

Yuki Konishi and Masanobu Miura

We analyzed the motion of performance using an acoustic and three electronic snare drums, and investigated the relationship between characteristics of rebound and electromyograms (EMG) on drummers' arms. We used the coefficient of the rebound as the characteristic of rebound to obtain the difference in the drumhead for each snare drum. Ten drummers (five professional and five intermediate) were asked to play single-strokes. We recorded surface EMGs signals from their performance for the four different snare drums. We measured surface EMG signals of the flexor carpi ulnaris muscle and extensor carpi ulnaris muscle of both arms. EMG signals on playing electronic snare drums are compared with those on playing acoustic snare drum. We found that electric drums with the high-value rebound coefficient increase the physi-

cal load for intermediate drummers whereas they decrease it for professional drummers, implying that only the professional drummers can take advantage of the rebound feature for suppressing the physical load when drumming.

IMAGERY AND PERFORMANCE

An fMRI study of expert musical imagery: To what extent do imagined and executed performance share the same neural substrate

Kirsteen Davidson-Kelly, Sujin Hong, Janani Dhinakaran, Joseph M. Sanders, Calum Gray, Edwin J. van Beek, Neil Roberts, and Katie Overy

Mental rehearsal is advocated as an expert learning strategy. Our research explores the neural basis of the type of multimodal musical imagery employed by expert pianists. We have developed functional neuroimaging paradigms to investigate musical imagery in more detail, in order to examine the reported benefits of mental rehearsal as an expert learning strategy. We report here on our preliminary findings.

Musical expertise and the planning of expression during performance

Laura Bishop, Freya Bailes, and Roger T. Dean

Musicians often say that the ability to imagine a desired sound is integral to expressive performance. Research suggests that musical imagery abilities improve with increasing musical expertise and that online imagery may guide expressive performance when sensory feedback is disrupted. However, the effects of sensory feedback deprivation on online imagery and the relationship between online imagery ability and musical expertise remain unclear. This study tested the hypotheses that imagery can occur concurrently with normal performance, that imagery ability improves with increasing musical expertise, and that imagery is most vivid when auditory feedback is absent but motor feedback present. Auditory and motor feedback conditions were manipulated as pianists performed two melodies expressively using the score. Dynamic and articulation markings were periodically introduced into the score and pianists indicated verbally whether the marking matched their intentions while continuing to play their own interpretation. Preliminary analyses suggest that, as expected, expressive profiles are most accurately replicated under normal feedback conditions but that imagery is most vivid in the absence of auditory feedback. The improvements to online imagery ability expected to co-occur with increasing musical expertise, if observed, will support the idea that enhanced imagery abilities contribute to expert musicians' extraordinary control over expression.

Rehearsal away from the instrument: What expert musicians understand by the terms "mental practice" and "score analysis"

Philip Fine and Anabela Bravo

Musicians commonly talk about "mental practice" and "score analysis" in referring to widely used strategies. But these terms may not be universally understood in the same way. Eighty-nine experienced musicians from the UK, Portugal, and Spain were asked what these terms meant to them and how useful they found the strategies. Mental practice was more likely to be considered very useful than score analysis was. Interpretative phenomenological analysis was used to investigate open-ended responses to the two terms. Various underlying themes emerged, including: mental practice and score analysis as a practical activity (e.g. studying the score, where and when this took place); psychological approaches to mental representations of music (e.g. cognitive processing, imagery, consciousness); usefulness of the strategies (e.g. interpretation for performance, identifying technical difficulties); and associations to the music (e.g. structural features, composer's intentions). The findings are discussed in terms of similarities and differences between mental practice and score analysis.

EXPRESSION AND INTERPRETATION

Expression of basic emotion on playing the snare drum

Masanobu Miura, Yuki Mito, and Hiroshi Kawakami

The motions used when expressing emotion in a musical performance are the target of this study, in which a professional percussionist was asked to play while expressing each of five basic emotions, such as anger, happiness, fear, sadness, and tenderness. The characteristic motions for expressing each of the emotions, such as the velocity and height of a drum-

stick, were then extracted, and these extracted motions were assumed to be the cues used by a player to express emotion. Finally, synthesized motions expressing each emotion were obtained by introducing a geometric average of the obtained motion data (.trc) as the average motion of each emotion. We then conducted an evaluation experiment to reproduce each of the emotions to be recognized and then confirmed that the motions actually represented a particular aspect of the emotional plane.

What can we learn from idiosyncratic performances? Exploring outliers in corpuses of Chopin renditions

Mitch Ohriner

Recent work in expressive timing has resulted in robust models that can predict much of the variance in the durations of events in performed music and generate convincing renditions. Many of these models translate a representation of musical structure into a map of performance decisions. But this translation treats "musical structure" as a ground truth from which performances might be generated or models might be assessed. An unfortunate consequence of this methodology is that idiosyncratic performances might be deemed poor reflections of musical structure. Yet most passages will afford multiple structural descriptions, and idiosyncratic renditions might be understood to widen a piece's interpretative range. In this article I focus on Joseph Stefanits's outlying rendition of the interior of Chopin's Nocturne in B*b* minor, Op. 9, No. 1, attempting to understand it as a novel description of the "structure" of the work. It is not my intention to criticize methods of scholarship that focus on conventional performances (without which Stefanits's rendition could not be called idiosyncratic): my aim instead is to construe performance as a source of knowledge in its own right, rather than just a reflection of musical structure.

Toward a multilevel model of expressive piano performance

Sebastian Flossmann and Gerhard Widmer

Expressive performance modeling requires different information for each expressive dimension. Most systems, however, rely on a single approach for all dimensions. Further, tempo and timing are mostly treated as one atomic entity instead of being decomposed into elements and treated separately. We propose a performance model that discriminates expressive dimensions with regard to the modeling approach and, additionally, uses separate subsystems to model tempo and timing.

THE SCIENCE OF STRING PLAYING

Mastering the violin: Motor learning in complex bowing skills

Erwin Schoonderwaldt and Eckart Altenmüller

A pilot study is presented comparing the performance of complex bowing patterns of three violinists. Analysis of the movements revealed a subtle coordination between string crossings and bow changes in repetitive bowing patterns across two and three strings. Clear differences between the performances of the three players were found that could be interpreted in terms of consistency and efficiency of movement. The pilot study forms an upbeat to a planned study to characterize the motor learning process in bowing skills from intermediate to expert level.

BowScribe: Supporting the violinist's performance model

Cordelia Hall, John T. O'Donnell, and Nicholas Bailey

Musicians often learn about their vision of a piece through practicing it and listening to recordings. However, this does not always free the player to develop his or her own interpretation of the piece, especially when technique is lacking. We have developed software, the *BowScribe* markup language, that supports a violinist in creating a "performance model" of a piece currently beyond his or her playing skills, by allowing the player fine control over tempo, volume, and articulation, including playing of chords, at a level of expressiveness and flexibility that is significantly beyond the MIDI playback modes of popular music notation software. BowScribe has been used by the first author (who was trained as a professional violinist) to create a model of the entire Bach *Chaconne* (edited by Galamian), a long and demanding piece of music for solo violin that has many phrases that span groups of chords as well as melodic passages. The markup language

specified chords to be rolled in two classic ways, as well as a wide variety of other strokes, including greater volume for individual notes in long slurs and small but essential variations in tempo.

Designing a didactic tool to facilitate the integration of improvisation in the teaching of violin: Content of the final prototype

Noémie L. Robidas

The goal of this study was to create a pedagogical tool to facilitate the integration of improvisation in the curriculum of violin lessons. Following a methodological approach specific to *development research*, the topics of the tool were determined according to the needs expressed by three violin teachers. Theoretical analyses linked to these topics were selected from literature specific to improvisation along with Tardif's Strategic Teaching Model and basic violin technique parameters and then developed into a series of practical pedagogical activities and strategies. The tool's prototype—a paper document including two DVDs—was evaluated by the researcher and the three participant teachers in collaboration with some of their pupils corresponding to the population target.

MEMORY AND ATTENTION IN PERFORMANCE

Attentional foci in piano performance

Felicia P.-H. Cheng, Philipp Heiß, Michael Großbach, and Eckart Altenmüller

Studies investigating the influence of the learner's focus of attention suggest that, in general, directing performers' attention to the *effects* of their movements (*external* focus of attention) is more beneficial than directing their attention to their own movements (*internal* focus of attention). It has been shown that different attentional foci are associated with different motor control processes, and internal focus may act as interference in the maintenance of a highly automated motor coordination. As an example of highly automated motor coordination, the present study aimed to investigate the effect of different attentional foci associated with expert piano playing. To this end, both the external focus (auditory feedback) and internal focus (fingering) were manipulated in order to explore their possible effects on piano playing. The main finding was the timing irregularity brought by manipulating the external focus (auditory feedback), but not the internal focus (motor pattern).

Annotation and the coordination of cognitive processes in Western Art Music performance

Linda T. Kaastra

This paper examines the role of performance annotations in coordinating Western Art Music (WAM) performance. Annotations are classified by their function in supporting cognitive and meta-cognitive processes of performance in relation to the printed score (visual salience, repair/correction, and anchoring). The classification supports theory in distributed cognition by demonstrating a clear functional relation between the annotated score and both internal and external performance processes.

Slow down and learn: Pianists and memory

Nancy Lee Harper, Tomás Henriques, Anabela Pereira, Inês Direito, João Paulo Cunha, Luís Souto Miranda, Filipa Tavares, and João Soares

This multi-disciplinary pilot study compared two groups of eight undergraduate pianists in a 3-week, 17-session experiment of a previously unknown 4-voice fugue (C. Schumann, Op. 16/2). The experimental group (EG, n=5) used adapted *Superlearning*™ techniques, which involved relaxation and controlled breathing with music chunking and a strong auditory-visual component. The control group (CG, n=3) was left free to study as desired. Both groups were asked to study only 30 minutes daily and to keep a practice journal during the 3.5-week experiment. Three trials were done. Prior to and after each trial, a battery of psychological tests was administered (stress, anxiety, life orientation, personality), as well as stress level monitoring through heart-rate variability through the use of a non-invasive T-shirt (*VitalJacket*®) and non-invasive cortisol saliva swabs. After the Trial 1 performance, the participants considered the study completed. A surprise Trial 2 was given 3 months later, followed by a Trial 3 performance two weeks after that. The results confirmed that the accelerated learning techniques functioned, but instead of having the desired effect of relaxation, the EG was more

stressed. Another surprising result was the success of the male pianists over the females, although this was not one of the objectives of the study.

Keynote paper

Thinking about performance: Memory, attention, and practice

Roger Chaffin

Performers must trust their memories to work reliably under the pressures of the concert stage. So, the performance must be thoroughly automatic. At the same time, it must be fresh and spontaneous in order to communicate emotionally with the audience. To learn how musicians resolve this dilemma, I have conducted longitudinal case studies of concert soloists preparing for performance. Our studies track memory development through practice to public performance and beyond. Like expert memorists in other domains, experienced musicians use highly practiced retrieval schemes. The retrieval organization provides a mental map of the piece that tells the performer what comes next—a series of landmarks, hierarchically organized by the sections and subsections of the music. The musician attends to these performance cues (PCs) in order to ensure that the performance unfolds as planned. PCs are established by thinking about particular features of the music during practice so that they later come to mind automatically. PCs help the musician to monitor the unfolding performance and adjust its rapid, automatic motor sequences to the needs of the moment.

Faculty of Music, University of Toronto

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Situated on the University's St George Campus, next to the Royal Ontario Museum, the Faculty houses a superb recital hall and opera theatre, in addition to state-of-the-art music studios and a library with over 250,000 volumes and 160,000 recordings.

The Faculty boasts an enviable track record for fostering musical talent and has trained performers, composers, educators, and scholars for leading careers in arts and educational organizations worldwide. Faculty members regularly win prestigious performing arts awards and top-ranked competitive research grants, and based on publications and citations, the University of Toronto leads Canadian research universities in music and fine arts.

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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.

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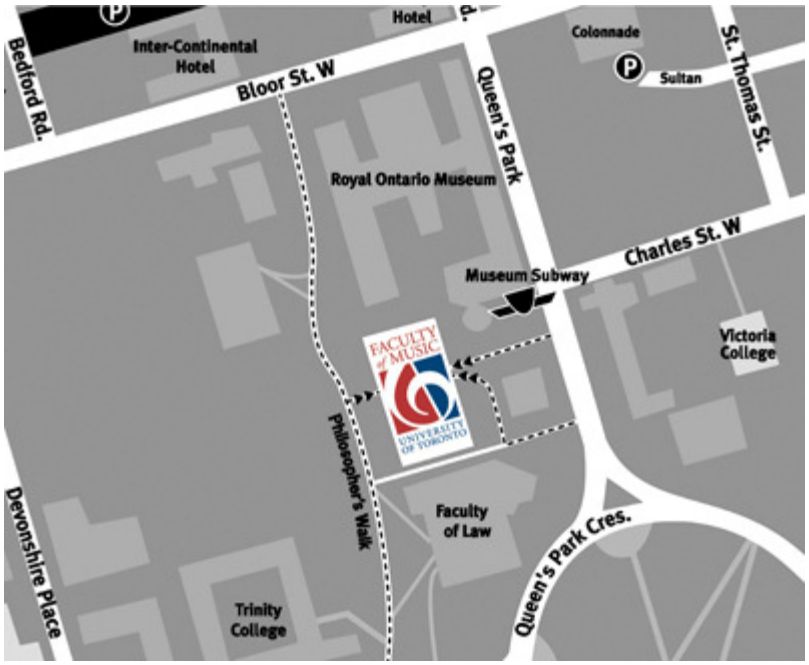
www.rcm.ac.uk/cps

Location map



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