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Welcome to ISPS 2009

The National Institute of Creative Arts and Industries (NICA) at The University of Auckland is delighted to host ISPS 2009, the second International Symposium on Performance Science. As a leading centre of creative, artistic, and professional excellence, we understand that the development and maintenance of elite performance is not purely an art form but also a science. We are proud to host this interdisciplinary conference in association with the Royal College of Music, London.

On behalf of NICA, the conference organizers, and the ISPS 2009 scientific committee I welcome you to Auckland and wish you the best for a rewarding and productive exchange of ideas.

Jenny Dixon
Dean, National Institute of Creative Arts and Industries
The University of Auckland

Scientific committee

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

Sharman Pretty, *co-chair*
The University of Melbourne (Australia)

Ralph Buck, *co-chair*
The University of Auckland (New Zealand)

Mayumi Adachi
Hokkaido University (Japan)

Eckart Altenmüller
Hanover University of Music and Drama (Germany)

Emmanuel Bigand
University of Burgundy (France)

Jane Boston
Royal Academy of Dramatic Arts (UK)

Daniela Coimbra
ESMAE, Porto Polytechnic Institute (Portugal)

Hubert Eiholzer
Conservatory of Italian Switzerland (Switzerland)

Dianna Kenny
The University of Sydney (Australia)

Alison McGregor
Imperial College London (UK)

Caroline Palmer
McGill University (Canada)

Miikka Peltomaa
Finnish Musicians' Medicine Association (Finland)

Emma Redding
Trinity Laban Conservatoire of Music and Dance (UK)

Dale Speedy
The University of Auckland (New Zealand)

General information for delegates

Reception and information desk

On Tuesday, 15 December, a registration desk will be situated in the lobby of the Fisher & Paykel Auditorium at The University of Auckland Business School from 14:00-17:00. Thereafter, a registration and information desk will be situated in the break-out space on Level 0 of the Business School from 08:30 on 16, 17, and 18 December.

Delegate pack

Your delegate pack should contain the following:

- delegate badge
- conference program
- conference proceedings
- ticket for conference dinner (if applicable)
- list of delegates
- pen and notepad
- campus map
- information booklet and map of Auckland City

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 Auckland.

Messages and notice board

A message and notice board will be situated near the information desk (Level 0 of the Business School) 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 Business School Reception on +64 9 923 3300. For urgent matters, messages can be left with Claire Speedy, the ISPS Conference Manager, on +64 (0) 210 259 5817.

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 Thursday, 17 December, from 19:00 at the Goldwater Estate, a local vineyard on Waiheke Island. Ferry transportation to Waiheke Island will depart from the Downtown Ferry Terminal (*address*: Pier 2, 99 Quay Street) at 18:00 sharp. Please be ready to board the ferry at 17:45. The return ferry will depart from Waiheke Island at 22:15, arriving at the Downtown Ferry Terminal at 23:00.

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 Auckland Business School is situated on Level 1, 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 111 to notify the Emergency Services, then notify the nearest member of staff (*campus security*: freephone 0800 373 7550 or dial 966 from an internal university phone). For any other urgent issues, contact Claire Speedy, the ISPS Conference Manager, on +64 (0) 210 259 5817.

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 Thursday, 17 December. Each poster has been allocated a number and should be placed on the board corresponding to that number. Posters should be mounted during the registration period (08:30-09:00) on 17 December. 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 17 December and should be removed by 16:00.

Quick reference timetable

Tuesday, 15 December 2009

14:00-17:00	Registration	Fisher & Paykel Auditorium Lobby, Business School
17:05-17:35	Kapa Haka performance	John Hood Plaza
17:35-18:05	Whakatau and welcome to ISPS 2009	Fisher & Paykel Auditorium
18:05-18:15	Brief intermission	
18:15-19:15	<i>Keynote address</i> Lord Robert Winston (Imperial College London) Performance, science, and society	Fisher & Paykel Auditorium
19:15-	Reception	Main Foyer, Business School

Wednesday, 16 December 2009

08:30-09:00	Registration	Foyer Level 0
09:00-10:00	<i>Keynote address</i> K. Anders Ericsson (Florida State University) Discovering deliberate practice activities that overcome plateaus and limits on improvement of performance	OGGB 3
10:00-10:30	Break (with refreshments)	Foyer Level 0
10:30-12:00	<i>Thematic sessions</i> Physical and psychological vulnerabilities in music and dance students The vocabulary of performance Performance analysis	Case Room 1 Case Room 2 Case Room 3
12:00-13:30	Lunch	Fale Pasifika
13:30-15:00	<i>Thematic sessions</i> Performance science: Implications for educational and professional practice Expression and interpretation I Expertise development	Case Room 1 Case Room 2 Case Room 3
15:00-15:30	Break (with refreshments)	Foyer Level 0
15:30-17:00	<i>Thematic sessions</i> Performance science (<i>cont.</i>) Expression and interpretation II Memory and performance	Case Room 1 Case Room 2 Case Room 3
17:00-17:15	Break	
17:15-18:00	<i>Graduate award paper</i> María Herrojo Ruiz (Hanover University of Music and Drama) Fast feedforward error-detection mechanisms in highly skilled performance	OGGB 3
18:00-18:30	Break	
18:30-	Len Lye screening and exhibition	Gus Fisher Gallery

Thursday, 17 December 2009

08:30-09:00	Registration	Foyer Level 0
09:00-10:00	<i>Keynote address</i> Deidre Anderson (Macquarie University) A balanced approach to excellence: Life skill intervention and elite performance	OGGB 3
10:00-10:30	Break (with refreshments)	Foyer Level 0
10:30-11:30	Poster session	Foyer Level 0
11:30-13:00	<i>Thematic sessions</i> Musician's dystonia: New aspects in pathophysiology and treatment Understanding performance The perception of technique	Case Room 1 Case Room 2 Case Room 3
13:00-14:00	Lunch	Fale Pasifika
14:00-15:30	<i>Thematic sessions</i> Musicians' dystonia (<i>cont.</i>) Emotion in performance	Case Room 1 Case Room 2
15:30-16:00	Break (with refreshments)	Foyer Level 0
16:00-17:00	<i>Workshops</i> Hearing and the noise of performance: Solutions for sound monitoring Taking microtonal composition and performance into the mainstream The art and science of historical performance	Case Room 1 Case Room 2 Theatre (Rm 117), Music School
17:00-17:45	Break	
17:45-18:45	Ferry to Waiheke Island (Departs 18:00 sharp, Pier 2, 99 Quay Street)	Downtown Ferry Terminal
19:00-	Conference dinner	Goldwater Estate, Waiheke Island

Friday, 18 December 2009

08:30-09:00	Registration	Foyer Level 0
09:00-10:30	<i>Thematic sessions</i> Student musicians' motivation, learning, and performance Performers' health Performance and life factors	Case Room 1 Case Room 2 Case Room 3
10:30-11:00	Break (with refreshments)	Foyer Level 0
11:00-12:30	<i>Thematic sessions</i> Student musicians' motivation (<i>cont.</i>) Physicality of performance Defining performance	Case Room 1 Case Room 2 Case Room 3
12:30-13:30	Lunch	Fale Pasifika
13:30-15:00	<i>Thematic sessions</i> Psychology of performance Perceiving performance	Case Room 1 Case Room 2
15:00-15:15	Break	
15:15-16:15	<i>Keynote address</i> Sylvie Fortin (University of Québec at Montreal) The dominant artistic discourse as a health determinant	OGGB 3
16:15-17:00	Closing remarks and announcement of ISPS 2011	OGGB 3

Social program

Wednesday, 16 December 2009

Screening and exhibition

Art that Moves: The Work of Len Lye

Curated by Roger Horrocks

Len Lye (1901-80) is one of the most original artists to have emerged from New Zealand. He developed his own theories about an “art of movement” as a new approach to art. He became known around the world for his animation films, pioneering the method of *direct film* (bypassing the camera by painting, scratching, and stenciling images directly onto celluloid). Later he became a pioneer of kinetic or motorized sculpture. His work has an energy and freshness that gives it broad appeal.

Art that Moves, the present exhibition of Lye’s films and sculptures, is the first at a public gallery in Auckland since 1980. It explores Lye’s intense engagement with what he called the “magical mystery” of motion. In addition to films and kinetic sculptures, there are paintings and photograms to represent other areas of his work and to illustrate the implied movement in his static images. Among the five kinetic sculptures in the show, there are two that have not previously been seen in Auckland.

A special screening of *Art that Moves*, directed by Roger Horrocks, and tour of the exhibition is available for delegates of ISPS 2009, beginning at 18:30 in the Gus Fisher Gallery (see location map, p.57). Entrance is open to all delegates and their partners. Delegates should wear their conference badge for entry.

Thursday, 17 December 2009

Conference dinner

Goldwater Estate, Waiheke Island

Waiheke Island is in the Hauraki Gulf of New Zealand, 17.7 km from Auckland (about 35 minutes by ferry). The island offers a picturesque blend of farmland, forest, beaches, vineyards, and olive groves.

The conference dinner will be served from 19:00, and special ferry transportation to Waiheke Island will be provided for ISPS delegates, departing at 18:00 sharp from the Downtown Ferry Terminal (*address*: Pier 2, 99 Quay Street). Please be ready to board the ferry at 17:45. The return ferry will depart from Waiheke Island at 22:15, arriving at the Downtown Ferry Terminal at 23:00. Dress is smart casual. Delegates should bring warm clothing for the ferry ride.

Tuesday, 15 December 2009

14:00-17:00	<p>REGISTRATION</p> <p>Fisher & Paykel Auditorium Lobby, Business School</p>
17:05-17:35	<p>KAPA HAKA PERFORMANCE</p> <p>John Hood Plaza</p>
17:35-18:05	<p>WHAKATAU and WELCOME TO ISPS 2009</p> <p>Fisher & Paykel Auditorium</p>
18:05-18:15	<p>BRIEF INTERMISSION</p>
18:15-19:15	<p>KEYNOTE ADDRESS</p> <p>Lord Robert Winston Imperial College London</p> <p>Performance, science, and society (p.24)</p> <p><i>Chair:</i> Jenny Dixon</p> <p>Fisher & Paykel Auditorium</p>
19:15-	<p>RECEPTION</p> <p>Main Foyer</p>

Wednesday, 16 December 2009

08:30-09:00	REGISTRATION Foyer Level 0		
09:00-10:00	KEYNOTE ADDRESS K. Anders Ericsson Florida State University Discovering deliberate practice activities that overcome plateaus and limits on improvement of performance (p.26) <i>Chair:</i> Aaron Williamon OGGB 3		
10:00-10:30	BREAK (with refreshments) Foyer Level 0		
10:30-12:00	<p style="text-align: center;"><u>SYMPOSIUM</u></p> <p>Physical and psychological vulnerabilities in music and dance students</p> <p style="text-align: center;"><i>Chair:</i> Ralph Buck Case Room 1</p> <p><u>Kenny, Cormack, Martin</u> Suffering for one's art: Performance related musculoskeletal disorders in tertiary performing arts students (p.26)</p> <p><u>Kenny, Martin, Cormack</u> Practicing perfection: The physical costs of practice in tertiary music and dance students (p.26)</p> <p style="text-align: center;"><u>Kenny</u> The factor structure of the revised Kenny Music Performance Anxiety Inventory (p.27)</p>	<p style="text-align: center;"><u>THEMATIC SESSION I</u></p> <p>The vocabulary of performance</p> <p style="text-align: center;"><i>Chair:</i> Dory Reeves Case Room 2</p> <p><u>Mitchell, MacDonald</u> Linguistic limitations of describing sound: Is talking about music like dancing about architecture? (p.27)</p> <p style="text-align: center;"><u>Fine, Ginsborg, Barlow</u> The influence of listeners' singing experience and the number of singers on the understanding of sung text (p.27)</p> <p><u>Chaffin, Demos, Crawford</u> The PC-survey: How does use of performance cues vary across musicians, instruments, musical styles, and performances? (p.27)</p>	<p style="text-align: center;"><u>THEMATIC SESSION II</u></p> <p>Performance analysis</p> <p style="text-align: center;"><i>Chair:</i> Graham Hair Case Room 3</p> <p><u>Goebel, Palmer</u> Finger motion in piano performance: Touch and tempo (p.28)</p> <p style="text-align: center;"><u>Molin</u> Quantitative multidimensional approach of technical pianistic level (p.28)</p> <p><u>Morita, Emura et al.</u> Evaluation of a scale performance on the piano using spline and regression models (p.28)</p>
12:00-13:30	LUNCH Fale Pasifika		

13:30-15:00	<p align="center"><u>SYMPOSIUM</u></p> <p>Performance science: Implications for educational and professional practice</p> <p><i>Chair and discussant:</i> Sharman Pretty</p> <p>Case Room 1</p> <p><u>Williamon, Wasley et al.</u> Profiling musicians' health, wellbeing, and performance (p.28)</p> <p><u>Redding, Irvine et al.</u> Dance science: Scientific investigations into the effect of dance specific fitness training and its impact upon pedagogic practices and dance performance (p.29)</p> <p><u>Clark, Williamon</u> Developing evidence-based interventions to enhance performance (p.29)</p>	<p align="center"><u>THEMATIC SESSION I</u></p> <p>Expression and interpretation I</p> <p><i>Chair:</i> Dorottya Fabian</p> <p>Case Room 2</p> <p><u>Senn, Kilchenmann, Camp</u> Expressive timing: Martha Argerich plays Chopin's Prelude op. 28/4 in E minor (p.30)</p> <p><u>MacKie</u> Controlling the pacing of retards and accelerandos in piano performance: A roller coaster solution? (p.30)</p> <p><u>Flossmann, Goebel, Widmer</u> Maintaining skill across the life span: Magaloff's entire Chopin at age 77 (p.30)</p>	<p align="center"><u>THEMATIC SESSION II</u></p> <p>Expertise development</p> <p><i>Chair:</i> Te Oti Rakena</p> <p>Case Room 3</p> <p><u>Aggett</u> Strategies for achieving performing excellence of twentieth and twenty-first century art song (p.30)</p> <p><u>Pertzborn, Coimbra et al.</u> Developing the ability to perform: Investigating the field of higher education and expertise development for learning and performing the double bass (p.30)</p> <p><u>Araújo, Cruz, Almeida</u> Pathways of excellence in science and dance: Lessons learned from a Portuguese case study (p.31)</p>
15:00-15:30	<p align="center">BREAK (with refreshments)</p> <p align="center">Foyer Level o</p>		
15:30-17:00	<p align="center"><u>SYMPOSIUM</u></p> <p>Performance science (cont.)</p> <p><i>Chair and discussant:</i> Sharman Pretty</p> <p>Case Room 1</p> <p><u>Altenmüller, Jabusch</u> How can neuroscience help performers? (p.29)</p> <p><u>Pretty</u> Symposium discussion</p>	<p align="center"><u>THEMATIC SESSION I</u></p> <p>Expression and interpretation II</p> <p><i>Chair:</i> Tânia Lisboa</p> <p>Case Room 2</p> <p><u>Fabian</u> Diversity and homogeneity in contemporary violin recordings of solo Bach (p.31)</p> <p><u>Collyer</u> Breathing in classical singing: Linking science and teaching (p.31)</p> <p><u>Palmer, Koopmans et al.</u> Synchronization of motion and timing in clarinet performance (p.31)</p>	<p align="center"><u>THEMATIC SESSION II</u></p> <p>Memory and performance</p> <p><i>Chair:</i> Roger Chaffin</p> <p>Case Room 3</p> <p><u>Fine, Bull</u> Memory for tactus and musical tempo: The effects of expertise and speed on keeping time (p.31)</p> <p><u>Stevens, Ginsborg, Lester</u> Moving backwards and forwards in time: Recalling dance from long-term memory (p.32)</p> <p><u>Carvalho, Rodrigues</u> Memory span in dance: Influence of age and experience (p.32)</p>

17:00-17:15	BREAK
17:15-18:00	GRADUATE AWARD PAPER María Herrojo Ruiz Hanover University of Music and Drama Fast feedforward error-detection mechanisms in highly skilled performance (p.32) <i>Chair:</i> Daniela Coimbra OGGB 3
18:00-18:30	BREAK
18:30-	LEN LYE SCREENING and EXHIBITION (p.9) Gus Fisher Gallery, Kenneth Myers Centre, 74 Shortland Street

Thursday, 17 December 2009

08:30-09:00	REGISTRATION Foyer Level 0
09:00-10:00	KEYNOTE ADDRESS Deidre Anderson Macquarie University A balanced approach to excellence: Life skill intervention and elite performance (p.34) <i>Chair:</i> Sharman Pretty OGGB 3
10:00-10:30	BREAK (with refreshments) Foyer Level 0
10:30-11:30	POSTER SESSION Foyer Level 0 Allen Memory consolidation in musicians: The effects of sleep, interference, and recall on musicians' performance of a keyboard melody (p.34) Atkins Health and wellbeing education in British conservatoires (p.34) Backus, Williamon Evidence of noise-induced hearing loss among orchestral musicians (p.35) Bajalica, Lockett Strategies for the pianist to enhance the artistic quality of piano recording (p.35) Bonini Baraldi, Bigand, Pozzo Analyzing and representing Transylvanian village music by using motion capture (p.35) Bravo, Fine Studying a score silently: What benefits can it bring to performance? (p.35) Burt-Perkins The learning cultures of performance: Applying a cultural theory of learning to conservatoire research (p.35) Carvalho, Marinho Musical narrative deconstruction: Ritual and transgression (p.36) dos Santos, Hentschke The piano repertoire preparation: A research method as a potential tool for reflective instrumental practice (p.36) Evans, Ackermann, Driscoll The role of the soft palate in woodwind and brass playing (p.36) Ferrari The Vincenzo Vitale piano school: Famous school but little known (p.36) Friedlander, Fine Expertise in cryptic crossword performance: An exploratory survey (p.37)

cont...

10:30-11:30	POSTER SESSION (cont.)	
	Fujisawa, Iwami <i>et al.</i>	Relationship between playing strategy and surface electromyograms in playing drums (p.37)
	Gaspar	Between hedonism and atomism: Discrepancies in the performers' musical perception (p.37)
	Goto	Effect of music in a healing room for recovery from mental fatigue: A psychological experiment of the relation between relaxing music and listening space design (p.37)
	Harper, Henriques, Halton	Performing proportion: Crux awareness in Scarlatti interpretation (p.38)
	Hsieh, Mioshi <i>et al.</i>	Piano playing skills in a patient with frontotemporal dementia: A longitudinal case study (p.38)
	Kinoshita, Obata	Chin force in violin playing (p.38)
	Kubota	The nature of professional accompanists and their roles: Performing with musical excellence and enjoying communicative interaction (p.38)
	Lisboa, Chaffin, Logan	How memory fades: Very-long-term recall of Bach (p.39)
	López, Pozo, Bautista	What do children think of music teachers? Their conceptions about cello teaching and learning (p.39)
	Marín Oller, Echeverría, Hallam	The use of musical scores in order to perform: An exploratory study with flute players (p.39)
	Martin	Pirouetting with pain: Attitudes surrounding female ballet dancers dancing with pain (p.39)
	Nakahara, Furuya <i>et al.</i>	Cardio-respiratory responses to expressiveness in piano performance (p.39)
	Nutti, Solomon, Williamon	The Listening Gallery: Integrating music with exhibitions and gallery displays (p.40)
	Obata, Nakahara <i>et al.</i>	Difficulty of violin vibrato in novice players: Fingerboard reaction force analysis (p.40)
	Santos-Luiz, Coimbra, da Silva	Musical learning and cognitive performance (p.40)
	Serra-Dawa	A longitudinal observation of one-to-one western singing lessons: The effects of personality and adult attachment (p.41)
	Thompson, Bennetts <i>et al.</i>	Emotional lingering: Facial expressions of musical closure (p.41)
	Trouli, Reissis	Pianists with carpal tunnel syndrome: Conservative versus surgical treatment (p.41)
	Wu, Lim <i>et al.</i>	Musical training facilitates brain plasticity: Short-term training effects on sensorimotor integration (p.41)

11:30-13:00	<p style="text-align: center;"><u>SYMPOSIUM</u></p> <p>Musician's dystonia: New aspects in pathophysiology and treatment</p> <p><i>Chair and discussant:</i> Aaron Williamon</p> <p>Case Room 1</p> <p><u>Schmidt, Jabusch et al.</u> Is musician's dystonia an inherited condition? (p.42)</p> <p><u>Herrojo Ruiz, Jabusch, Altenmüller</u> New aspects in action planning and execution in musicians with dystonia (p.42)</p> <p><u>Altenmüller, Granert et al.</u> Functional and morphological changes of brain structures in patients suffering from musician's dystonia (p.42)</p>	<p style="text-align: center;"><u>THEMATIC SESSION I</u></p> <p>Understanding performance</p> <p><i>Chair:</i> Terry Clark</p> <p>Case Room 2</p> <p><u>Bangert</u> Doing without thinking? Aspects of musical decision-making (p.43)</p> <p><u>Esteban Muñoz</u> Applications of formal analysis: Musical comprehension and memory consolidation in performance (p.43)</p> <p><u>Geeves, McIlwain</u> That blissful feeling: Phenomenological conceptions of music performance from one performer's perspective (p.43)</p>	<p style="text-align: center;"><u>THEMATIC SESSION II</u></p> <p>The perception of technique</p> <p><i>Chair:</i> Gary McPherson</p> <p>Case Room 3</p> <p><u>Lisboa, Gualda</u> Left-hand expression in cello playing: Exploring approaches to shifting (p.44)</p> <p><u>Obata, Nakahara et al.</u> Fingering force in violin vibrato (p.44)</p> <p><u>Yasui, Kinou, Miura</u> Fluctuation strength of tremolo played on the mandolin: How is tremolo evaluated as good? (p.44)</p>
13:00-14:00	<p>LUNCH</p> <p>Fale Pasifika</p>		
14:00-15:30	<p style="text-align: center;"><u>SYMPOSIUM</u></p> <p>Musicians' dystonia (cont.)</p> <p><i>Chair and discussant:</i> Aaron Williamon</p> <p>Case Room 1</p> <p><u>Jabusch, Buttkus et al.</u> Setting the stage for prevention and treatment: New therapeutic approaches in musician's dystonia (p.43)</p> <p><u>de Lisle, Speedy, Thompson</u> The effects of pianistic retraining via video conferencing as a means of assisting recovery from focal dystonia: A case study (p.43)</p> <p><u>Williamon</u> Symposium discussion</p>	<p style="text-align: center;"><u>THEMATIC SESSION I</u></p> <p>Emotion in performance</p> <p><i>Chair:</i> Te Oti Rakena</p> <p>Case Room 2</p> <p><u>Kochman, Leman, DeClerk</u> The effects of musical syntax on perception of music performance (p.44)</p> <p><u>Livingstone, Schubert et al.</u> Emotional arousal and the automatic detection of musical phrase boundaries (p.45)</p> <p><u>Gerling, dos Santos, Domenici</u> Communicating emotion in piano performance (p.45)</p>	
15:30-16:00	<p>BREAK</p> <p>(with refreshments)</p> <p>Foyer Level o</p>		

16:00-17:00	<p style="text-align: center;"><u>WORKSHOP I</u></p> <p style="text-align: center;">Hearing and the noise of performance: Solutions for sound monitoring</p> <p style="text-align: center;">Case Room 1</p> <p style="text-align: center;"><u>Williamon, Backus <i>et al.</i></u></p> <p>This workshop showcases recent initiatives that have brought together artists and scientists to generate practical solutions and new technology for monitoring noise and protecting hearing, while having little or no impact on the quality of performers' work (p.45)</p>	<p style="text-align: center;"><u>WORKSHOP II</u></p> <p style="text-align: center;">Taking microtonal composition and performance from the periphery into the mainstream</p> <p style="text-align: center;">Case Room 2</p> <p style="text-align: center;"><u>Hair, Bailey, Swayne</u></p> <p>The workshop draws on a number of sources from experimental composition and performance traditions, and harnesses, develops, and extends them to invigorate mainstream approaches to vocal performance (p.45)</p>	<p style="text-align: center;"><u>WORKSHOP III</u></p> <p style="text-align: center;">The art and science of historical performance</p> <p style="text-align: center;">Theatre (Rm 117), Music School</p> <p style="text-align: center;"><u>Lawson, Tibbles</u></p> <p>This workshop deconstructs period performances of music for clarinet and fortepiano by Mozart, Stadler, and Vanhal, distinguishing historical elements from those aspects of art and science that are arguably rooted in the twenty-first century (p.46)</p>
17:00-17:45	BREAK		
17:45-18:45	<p>FERRY TO WAIHEKE ISLAND (Departs at 18:00 sharp)</p> <p>Downtown Ferry Terminal, Pier 2, 99 Quay Street</p>		
18:45-	<p>CONFERENCE DINNER (p.9)</p> <p>Goldwater Estate, Waiheke Island</p>		

Friday, 18 December 2009

08:30-09:00	REGISTRATION Foyer Level 0		
09:00-10:30	<p style="text-align: center;"><u>SYMPOSIUM</u></p> <p>Student musicians' motivation, learning, and performance</p> <p style="text-align: center;"><i>Chair and discussant:</i> Philip Fine</p> <p style="text-align: center;">Case Room 1</p> <p style="text-align: center;"><u>Renwick, McPherson</u></p> <p>Multiple motives: Profiles of young Australians' reasons for musical engagement (p.48)</p> <p style="text-align: center;"><u>McPherson</u></p> <p>Playing together in ways that cater for and fulfill students' psychological needs (p.48)</p> <p style="text-align: center;"><u>Ginsborg</u></p> <p>Focus, effort, and enjoyment in chamber music: Rehearsal strategies of successful and "failed" ensembles (p.48)</p>	<p style="text-align: center;"><u>THEMATIC SESSION I</u></p> <p style="text-align: center;">Performers' health</p> <p style="text-align: center;"><i>Chair:</i> Rae de Lisle</p> <p style="text-align: center;">Case Room 2</p> <p style="text-align: center;"><u>Steinmetz</u></p> <p>Influence of musculoskeletal dysfunction and pain on performance excellence (p.49)</p> <p style="text-align: center;"><u>Lourenço, Clemente et al.</u></p> <p>Do pianists play with their teeth? (p.49)</p> <p style="text-align: center;"><u>Evans, Trouli</u></p> <p>ISSTIP performing arts clinics at the London College of Music 1990-2005 (p.49)</p>	<p style="text-align: center;"><u>THEMATIC SESSION II</u></p> <p style="text-align: center;">Performance and life factors</p> <p style="text-align: center;"><i>Chair:</i> Ralph Buck</p> <p style="text-align: center;">Case Room 3</p> <p style="text-align: center;"><u>Erskine, Ainley</u></p> <p>Diversity of dancer experience in a dance program (p.50)</p> <p style="text-align: center;"><u>Snook</u></p> <p>A circle of life: The Caroline Plummer Fellowship in Community Dance (p.50)</p> <p style="text-align: center;"><u>Pollitt, Bennett</u></p> <p>Choosing the unstable: Dancing through the mid-career (p.50)</p>
10:30-11:00	BREAK (with refreshments) Foyer Level 0		
11:00-12:30	<p style="text-align: center;"><u>SYMPOSIUM</u></p> <p>Student musicians' motivation (cont.)</p> <p style="text-align: center;"><i>Chair and discussant:</i> Philip Fine</p> <p style="text-align: center;">Case Room 1</p> <p style="text-align: center;"><u>Kenny, Fortune, Ackermann</u></p> <p>What predicts performance excellence in tertiary level music students? (p.48)</p> <p style="text-align: center;"><u>Fine</u></p> <p>Symposium discussion</p>	<p style="text-align: center;"><u>THEMATIC SESSION I</u></p> <p style="text-align: center;">Physicality of performance</p> <p style="text-align: center;"><i>Chair:</i> Dory Reeves</p> <p style="text-align: center;">Case Room 2</p> <p style="text-align: center;"><u>Broughton, Stevens</u></p> <p>Physical movement and imagery in professional and student solo marimba practice (p.50)</p> <p style="text-align: center;"><u>Xarez, Pereira, Mendonça</u></p> <p>Monitoring work and rest during performance and life-style: A study case with a principal ballet dancer (p.51)</p> <p style="text-align: center;"><u>Wyon, Twitchett et al.</u></p> <p>Will fitness training have an affect on the aesthetics of dance performance? (p.51)</p>	<p style="text-align: center;"><u>THEMATIC SESSION II</u></p> <p style="text-align: center;">Defining performance</p> <p style="text-align: center;"><i>Chair:</i> Rosie Burt-Perkins</p> <p style="text-align: center;">Case Room 3</p> <p style="text-align: center;"><u>Correia</u></p> <p>Is composition a mode of performing? Questioning musical meaning (p.51)</p> <p style="text-align: center;"><u>Phillips</u></p> <p>Seeking excellence in danced postgraduate degrees (p.51)</p> <p style="text-align: center;"><u>Marinho, Carvalho</u></p> <p>Intention revisited: From composition to performance (p.52)</p>

12:30-13:30	<p>LUNCH</p> <p>Fale Pasifika</p>		
13:30-15:00		<p><u>THEMATIC SESSION I</u></p> <p>Psychology of performance</p> <p><i>Chair:</i> Jane Ginsborg</p> <p>Case Room 2</p> <p><u>Stambaugh</u></p> <p>When repetition isn't the best practice strategy: Examining differing levels of contextual interference during practice (p.52)</p> <p><u>Clark, Williamon</u></p> <p>Imaging the music: A context-specific method for assessing imagery ability (p.52)</p> <p><u>Bigand, Pozzo, Beraut</u></p> <p>Learning to play double bass by stimulating mental imagery (p.52)</p>	<p><u>THEMATIC SESSION II</u></p> <p>Perceiving performance</p> <p><i>Chair:</i> James Renwick</p> <p>Case Room 3</p> <p><u>Pullinger, Bailey et al.</u></p> <p>Computer assisted analysis and display of musical and performance data (p.53)</p> <p><u>MacRitchie, Buck, Bailey</u></p> <p>Gestural communication: Linking multimodal analysis of performance to perception of musical structure (p.53)</p> <p><u>Dodd</u></p> <p>Music performance venues: Keeping them in tune with modern requirements (p.53)</p>
15:00-15:15	<p>BREAK</p>		
15:15-16:15	<p>KEYNOTE ADDRESS</p> <p>Sylvie Fortin</p> <p>University of Québec at Montreal</p> <p>The dominant artistic discourse as a health determinant (p.54)</p> <p><i>Chair:</i> Ralph Buck</p> <p>OGGB 3</p>		
16:15-17:00	<p>CLOSING REMARKS and ANNOUNCEMENT OF ISPS 2011</p> <p>OGGB 3</p>		

Abstracts
Tuesday, 15 December 2009

Keynote paper

Performance, science, and society

Robert Winston

The evaluation of music and musicality is of growing interest to scientists. Various technologies, particularly functional brain imaging, have increased our understanding of the perception of music, pitch, and rhythm, and research into the physiology of performance and the physics of acoustics are now important academic disciplines. There is now awareness that inspiration, intuition, and emotion are as important to the exploration of neuroscience as they are to composing and performing. Music is an art that gets closest to the basis of our humanity and opens windows of perception in unique and varied ways. This is why music is so important in human experience—from Shostakovich reflecting on death in intensive care at the end of his Fifteenth Symphony, to the Prince ludicrously elevated from his melancholy in Prokofiev's *March of the Love for Three Oranges*. And this aspect of music, its ability to manipulate our mind, has been used in various ways—from musak in supermarkets, to the pipes at Culloden or the drums and trumpets of soldiers marching into battle, from Furtwangler conducting Wagner in front of the Nazi faithful, to Puccini at a football match. This paper examines some of the relationships between music, science, and society.

Abstracts

Wednesday, 16 December 2009

Keynote paper

Discovering deliberate practice activities that overcome plateaus and limits on improvement of performance

K. Anders Ericsson

Since Sir Francis Galton's book on *Hereditary Genius*, many scientists have argued that heritable factors set limits of performance and only allow a select few individuals to attain exceptional levels. However, recent research rejects the associated learning theory and its implied performance plateaus and shows that expert performance is mediated by acquired complex cognitive mechanisms. It describes different types of deliberate practice activities that develop and refine mental representations, which in turn permit attained performance to exceed performance resulting from extensive experience only. Empirical investigations are reviewed to show that expert performance and outstanding achievements will be primarily constrained by individuals' engagement in deliberate practice and the quality of the available training resources.

Thematic Sessions

SYMPOSIUM: PHYSICAL AND PSYCHOLOGICAL VULNERABILITIES IN MUSIC AND DANCE STUDENTS

Suffering for one's art: Performance related musculoskeletal disorders in tertiary performing arts students in music and dance

Dianna T. Kenny, Justine Cormack, and Rosemary Martin

The study reports the results of an intake questionnaire assessing point prevalence of performance related musculoskeletal disorders (PRMD) and pain in 151 tertiary level performing arts students in music and dance. Forty percent reported having received a medical diagnosis for a condition related to playing their instrument or performing their dance style. The most common diagnoses for music students were repetitive sprains and strains such as tennis elbow, carpal tunnel syndrome, tendonitis, tenosynovitis, and muscle tightness, including temporo-mandibular joint syndrome, tight embouchure, muscle spasm, numbness, and cramping. Sixty-four percent of the dance students had serious injuries such as broken bones, joint dislocations, cruciate ligament and meniscus tears and strains, other muscle tears, and sprains/strains in biceps, hamstrings, and ankles, tightening in hamstrings and hips, and bunions. Only 27% of the total sample reported no current pain from a PRMD; 11.3% reported suffering daily or almost daily from a PRMD. Given the high injury rates among performing arts students, injury surveillance systems may be a cost effective way to identify high risk injuries in specific cohorts, and to apply appropriately specific management and prevention strategies for musicians and dancers during their training in order to assist in the development of sustainable careers.

Practicing perfection: The physical costs of practice in tertiary music and dance students

Dianna T. Kenny, Rosemary Martin, and Justine Cormack

Despite the many physical demands involved in practice in music and dance, little attention has been paid to the impact of practice on the musculoskeletal system of young performers. We, therefore, assessed whether the amount of daily practice and the practice and rehearsal routines of tertiary music and dance students were related to the frequency and severity of reported performance related musculoskeletal disorders (PRMD) in 109 music and 42 dance (36% males) from The National Institute of Creative Arts and Industries, University of Auckland. Music students practiced, on average, 156 minutes per day, compared with 107.5 minutes for dance students. Music students spent an average of 401 minutes and dance students spent an average of 369 minutes per week rehearsing with others. Contrary to prediction, linear regression analyses showed no relationship between PRMD frequency, severity or duration, and any of the practice factors assessed. Although excessive practice is frequently cited by performing artists as one of the contributors to PRMD, this study did not confirm a relationship between practice and PRMD in this sample. It is possible that the amount of practice (2.6 hours per day in music students and 1.8 hours for dancers) fell below the threshold for a pain inducing practice period, particularly as these students reported taking rest breaks

after 48 (dancers) and 60 (music) minutes' practice. Further research is needed to assess the relationship between PRMD and practice.

The factor structure of the revised Kenny Music Performance Anxiety Inventory

Dianna T. Kenny

This study assessed the factor structure of the revised Kenny Music Performance Anxiety Inventory (KMPAI) using a sample ($n=151$) of tertiary music and dance students attending the National Institute of Creative Arts and Industries, University of Auckland. The scale consists of 40 items that assess the factor structure of the revised, expanded KMPAI to ascertain whether it captured the latent etiological factors identified by emotion theory underlying performance anxiety. Students completed the (revised) Kenny Music Performance Anxiety Inventory at the commencement of the 2009 academic year. Principal component analysis (with varimax rotation) of the KMPAI revealed three latent factors and 12 underlying factors, as follows: early relationship context comprising generational transmission of anxiety and parental empathy; psychological vulnerability comprising controllability, depression, hopelessness, and trust; and proximal performance concerns comprising somatic anxiety, pre- and post-performance rumination, self/other scrutiny, performance outcome concerns, memory reliability, and commitment to performance. These results provide initial evidence of the complex structure of music performance anxiety, particularly in its severe form, and indicate that management and treatment of the condition will need to be tailored to the individual's pattern of contributing causal features.

THE VOCABULARY OF PERFORMANCE

Linguistic limitations of describing sound: Is talking about music like dancing about architecture?

Helen F. Mitchell and Raymond A. R. MacDonald

Verbalizing sound quality presents a challenge to musicians and pedagogues in describing a complex sensory phenomenon. Verbal descriptions may only be effective when a performer's sound translates easily and completely into words. A verbal overshadowing (VO) effect may occur when a verbal description distorts the recall of the original aural memory. The aim of this study is to examine the impact of verbal overshadowing in a music performance context. This exploratory pilot project builds on VO research in other fields to assess the value and limitations of language in describing performers' sound quality. Outcomes will have implications for musicians and pedagogues in the use of language in music teaching and learning.

The influence of listeners' singing experience and the number of singers on the understanding of sung text

Philip Fine, Jane Ginsborg, and Chris Barlow

An important aspect of perceiving sung music is understanding the words. Previous research has suggested several factors affecting the intelligibility of sung text. This study investigates two of those factors: the number of singers and the singing expertise of the listener. We expected more singers to cause greater variability in the acoustic signal and be harder to comprehend. Listeners who are themselves experienced singers are more likely to be attuned to factors affecting singers' diction and were expected to be better than non-singers at understanding the sung text. Forty eight participants, half accomplished singers and half self-reported non-singers, listened to four 8-bar unaccompanied songs twice (in order to test for familiarity) and wrote out the texts as they heard them. Two performances were given by a soloist, two by a trio of singers in unison. Participants were significantly better at understanding the words on the second hearing than the first, and singers significantly better than non-singers overall. There was no effect of the number of singers. Hence familiarity and singing experience both benefited sung text understanding. An effect of the number of singers may be more apparent when comparing a soloist with a choir.

The PC-survey: How does use of performance cues vary across musicians, instruments, musical styles, and performances?

Roger Chaffin, Alexander Demos, and Mary Crawford

Performance cues (PCs) are the mental landmarks that a musician monitors to track the progress of a piece as it unfolds during performance. We describe a survey to determine how PC use is affected by experience, instrument, musical style, and by the goals of the performance. We summarize results from longitudinal case studies in which PCs

were reported to suggest the kind of variation to be found. Understanding how musicians use PCs should improve pedagogy by increasing our understanding of how musicians memorize.

PERFORMANCE ANALYSIS

Finger motion in piano performance: Touch and tempo

Werner Goebel and Caroline Palmer

This study investigated movement properties of pianists' fingers with three-dimensional motion capture technology while pianists performed melodic passages at a range of tempi. The main question was whether finger motion dynamics change with performance tempo, an important issue for practicing and training. Kinematic landmarks determined from the finger trajectories changed considerably as the tempo became faster; piano touch was under deliberate control only at slow tempi. Individual differences in performance speed led to specific claims about desirable finger dynamics for successful piano playing.

Quantitative multidimensional approach of technical pianistic level

Paul Molin

The purpose of this study is to examine whether it is possible to define quantitatively the technical level of a pianist by summarizing the individual characteristics of the pianist's technical ability in a few—at most three—dependent variables. These variables could be used in competitions and examinations as well as by piano teachers to measure students' progress, or by the students themselves in their daily work.

Evaluation of a scale performance on the piano using spline and regression models

Shinya Morita, Norio Emura, Masanobu Miura, Seiko Akinaga, and Masuzo Yanagida

Recently, many systems have been developed for supporting novice and/or beginner pianists. Even though these systems use a set of performance data, they cannot properly evaluate performance proficiency because a procedure for calculating proficiency has not been proposed. To solve this problem, we have developed an evaluation model by introducing a spline curve or regression curve, assuming it to be a standard for evaluating proficiency for scale performances from an aesthetic viewpoint. This paper introduces other models for evaluation, comprised of a standard curve for evaluating a piano performance. Curves used are (1) a spline curve and (2) regression curves using n -dimensional models ($1 \leq n \leq 10$). Investigated here is the effectiveness of the curves, so as to determine a better curve for automatically evaluating performance. As a result, correlation coefficients between scores predicted by the spline curve model and evaluation scores by experts were 0.65, whereas the average of correlation coefficients between scores predicted by regression curves models and evaluation scores by experts was 0.58. In other words, a correlation coefficient of the spline curve model is confirmed to be higher than those of regression curve models. Therefore, it was confirmed that the spline curve model is more effective than n -dimensional curves at automatically evaluating performance.

SYMPOSIUM:

PERFORMANCE SCIENCE:

IMPLICATIONS FOR EDUCATIONAL AND PROFESSIONAL PRACTICE

Profiling musicians' health, wellbeing, and performance

Aaron Williamon, David Wasley, Rosie Burt-Perkins, Jane Ginsborg, and Wulf Hildebrandt

This study profiles music students' physical and mental fitness for performance. Participants were recruited from the Royal College of Music (RCM, $n=59$) and Royal Northern College of Music (RNCM, $n=32$), and standardized measures of health promoting behaviors, anxiety, perfectionism, cardiovascular fitness, and physical strength and flexibility were employed to assess students' performance-related health and wellbeing. The resulting profile indicates that (1) students tend to fall outside of their target BMI, with more students falling below their target than above it, (2) cardiovascular fitness is most frequently below average or average, with under 40% of students achieving above average cardiovascular fitness, (3) student fatigue correlates variously with aspects of perfectionism, trait anxiety, health promotion, and self-regulated learning, and (4) pain that is reported to stop performance is most often linked to the upper arm/elbow, left and right hands, and the back. The value of such profiling exercises in educational contexts is discussed, with examples of implementation drawn from a UK conservatoire.

Dance science: Scientific investigations into the effect of dance specific fitness training and its impact upon pedagogic practices and dance performance

Emma Redding, Sarah Irvine, Edel Quin, and Sonia Rafferty

Dance training has developed eclectically to serve the different approaches to dance performance and making; however, there is a discrepancy between the physiological demands of training and dance performance. It is no longer acceptable to train dancers without due regard for physiological concerns if they are to be prepared appropriately to meet the demands of current choreographic work. Research over the last two decades has examined the physical fitness status of professional and student dancers', but there is still debate about how fit dancers *should* be. There is a discrepancy in the physical intensity level between training, rehearsal, and performance, and the idea of supplementary fitness training has been debated, albeit untested longitudinally with large groups of dancers. The purpose of this study was to examine the effect of a one-year dance specific fitness program on undergraduate contemporary dance students undertaking full-time vocational training and to observe any impact the findings may make upon dance pedagogic practices. Results from the pre- and post-screening assessments show that, following the intervention, there was a significant decrease ($p < 0.05$) in mean heart rates across all five stages of the Dance Aerobic Fitness Test (DAFT), indicating improvement in the dancers' aerobic capabilities. Findings impacted upon the school curriculum, in that the timetable now comprises weekly fitness classes.

Developing evidence-based interventions to enhance performance

Terry Clark and Aaron Williamon

Increasingly, a broader range of training programs and evidence-based interventions are being employed within music education contexts. It is important that these programs are empirically tested to provide an unbiased assessment of their impact and efficacy. This article highlights methods for developing and testing intervention programs. A nine-week musician-specific mental skills training program was developed and delivered to performance students from the Royal College of Music (RCM). Pre- and post-testing involved a battery of questionnaires, public performances, and performance-related tasks. Feedback from these students was collected throughout concerning their views on the relevance and usefulness of the program. In comparison with a control group, this experimental group demonstrated significant changes in their views toward practice activities and specific practicing behaviors. A significant increase in self-efficacy for performing was also found for the experimental group, as was an increase in imagery vividness. These results are further supported by comments from students in the experimental group revealing greater levels of self-awareness and confidence, facilitative views toward and heightened control over anxiety, and healthier perspectives toward music making. Feedback from the participants also provided insight into issues pertaining to content and delivery.

How can neuroscience help performers?

Eckart Altenmüller and Hans-Christian Jabusch

Many neuroscientists are interested in musicians and in the neurobiology of music perception and performance. This interest is usually motivated by the attractiveness of the topic (music as an art) and by the enormous effects of music on brain networks and brain morphology, demonstrating the powerful mechanisms of brain plasticity in the short- and long-term range. Therefore, most neuroscientists consider music as an excellent paradigm to study brain mechanisms related to sensorimotor or perceptive learning. However, it remains open as to whether the growing body of research in this area has been made fertile for musicians, for example with respect to improvement of practice or teaching strategies. We report new results of brain imaging studies focusing on sensorimotor integration while novices learn to play the piano. Interestingly, auditory-sensorimotor integration can be established in less than 20 mins of piano practice, demonstrating the dynamics of brain plasticity in this specific task. Implications include the usefulness of pure auditory stimulation for the acquisition of skilled finger movements. Furthermore, we review recently published work on error monitoring in skilled pianists. This research demonstrates that errors are already "identified" by the brain 50 ms prior to their actual execution. We discuss this finding with respect to practical consequences concerning error avoidance. Based on these studies, we demonstrate the utility of some neuroscience research for musicians, particularly when the researchers themselves are trained musicians and work diligently to translate their findings from one discipline to the other.

EXPRESSION AND INTERPRETATION I

Expressive timing: Martha Argerich plays Chopin's Prelude op. 28/4 in E minor

Olivier Senn, Lorenz Kilchenmann, and Marc-Antoine Camp

This paper scrutinizes the temporal organization of Martha Argerich's interpretation of Chopin's Prelude op. 28/4 in E minor, recorded in 1975 for Deutsche Grammophon (DG 415 836-2). It proposes a method for extracting the timing of the attacks from the audio signal, it visualizes the data of bars 1-4, and maps Argerich's timing to Chopin's composition in a process of "inverse interpretation."

Controlling the pacing of retards and accelerandos in piano performance: A roller coaster solution?

Cristine MacKie

Performers of a musical work generally well understand how to control steady tempos carried by the musical beat. More problematic for the performer, however, is controlling the graduated pacing of flexible tempos such as retards and accelerandos that depart from, yet link, the established tempos. According to Epstein (1995), the pacing of retards and accelerandos in performance is among the least accomplished events in our concert halls; indeed it is often left to chance. In this article, I propose that the performer may control the pacing of the ascent and descent of the melodic curves which characterize *Bruyères*, a prelude from *Book 2* for piano by Debussy, by using a subtle application of retards and accelerandos following the principle of the roller coaster. However, the retards and accelerandos, like the roller coaster, also require some means of support. I shall suggest too that Debussy's deployment of cadences is intended to give support to that pacing. But how may the performer achieve this?

Maintaining skill across the life span: Magaloff's entire Chopin at age 77

Sebastian Flossmann, Werner Goebel, and Gerhard Widmer

The study is based on a corpus containing the entire works of Chopin performed by Nikita Magaloff at the age of 77, precisely measured and fully annotated with score information. On this data, we test a model of successful aging including selection, optimization, and compensation hypotheses (SOC). We identify performance errors, compare Magaloff's etudes with recordings by 14 other renowned pianists, and investigate specific age effects in a selected nocturne in 14 different recordings.

EXPERTISE DEVELOPMENT

Strategies for achieving performing excellence of twentieth and twenty-first century art song

Cathy Aggett

Strategies professional singers use in the selection and preparation of twentieth and twenty-first century art song were gathered from an international study carried out by email during 2006-07. These strategies were applied in the preparation of 34 Australian art songs for a recital in 2008 by three professional singers in a practice-led research project involving the author. The 84 resulting performance and learning strategies from the professional singers' study are discussed in relation to the literature and their application by the three singers who strove for performance excellence in their preparation and performance of a recital of these Australian art songs. The application of how these strategies can ultimately benefit singers and vocal teachers learning and performing twentieth and twenty-first century art song is discussed, along with the categorization of the strategies with reference to the literature.

Developing the ability to perform: Investigating the field of higher education and expertise development for learning and performing the double bass

Florian Pertzborn, Daniela Coimbra, Susan Hallam, and Ana Cristina Braga

The aim of the present study was to find out if there were significant differences between the learning student, the supervising professor, and the expert performer working in a symphony orchestra regarding the development of their ability to perform. Survey results demonstrate that all groups showed a secure level of understanding of the concepts of deliberate practice and self-awareness, while those of metacognition were practically unknown. While students reported the most practice of all groups, they rarely record themselves or use computer technology. All participants were highly supported by their parents especially at the time when they decided to become a professional. The instrumental diversity of size, *scordatura*, playing postures or bowing schools was seen as an advantage rather than a disadvantage, overruling statements of previously undertaken research. The study highlights the importance of early pre-professional learning for the university student.

Pathways of excellence in science and dance: Lessons learned from a Portuguese case study

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

Many researchers are studying the early identification of exceptional individuals, expertise acquisition, personality, and the role of external catalysts, aspiring to explain their influence on the process of talent and expertise development. Researchers seek a deeper understanding of these exceptional individuals, using multiple methodologies and techniques, studying multiple contexts and domains, and focusing on multiple dimensions and constructs associated with excellence. Moreover, much psychological research on excellence takes a predominantly outsider perspective favoring quantitative inquiry, but little is really known about the experiences and personal meanings of exceptional individuals. In this study, we explored the insider perspective of being excellent. Using a case study approach, two dancers and two scientists were interviewed. A theoretically-oriented content analysis grid was constructed to assist data analysis. Overall, participants stressed personal characteristics such as extreme curiosity, persistence, and passion for their work as central features in nurturing and sustaining their motivation for practice, and also as key features of being an excellent performer. Additionally, intensive and hard work, discipline, and strong commitment were emphasized and other personal and contextual dimensions highlighted. Singularities and some reflections that emerged from this study are discussed.

EXPRESSION AND INTERPRETATION II

Diversity and homogeneity in contemporary violin recordings of solo Bach

Dorottya Fabian

Over 20 recent commercial recordings of Bach's solos for violin were studied to examine performance trends of the last 25 years and to test the widely held opinion that style has become fairly homogenous and lacking in individuality. The main trends found were the influence of historically informed practices (e.g. in bowing, fingering, vibrato) and a move toward greater flexibility in phrasing and rhythmic delivery. Both strong and subtle individual differences were observable, but these seem less suitable for quantitative reporting.

Breathing in classical singing: Linking science and teaching

Sally Collyer

This article addresses three issues. Firstly, breathing studies of trained classical singers have found high inter-singer variability, which raises many questions about the nature and role of breathing in singing; these study findings and their implications are discussed from a pedagogical perspective. Secondly, the article examines the resulting limitations inherent in a segmented model that divides voice into respiration, phonation, and articulation and that excludes key components from a narrow concept of a "breathing system." Finally, the article examines how this wider paradigm of singing-breathing inevitably positions breathing at the confluence of technique, emotion, and musical line.

Synchronization of motion and timing in clarinet performance

Caroline Palmer, Erik Koopmans, Christine Carter, Janeen D. Loehr, and Marcelo Wanderley

We examined the effect of expressive intent on timing and movement in clarinet performance. Clarinetists' performances were recorded with motion capture while they performed with three expressive intents: expressive (normal) performance, exaggerated performance, and inexpressive performance. Acoustic measures (intensity, pitch height, duration) were compared with ancillary gestures (bell movement). The more expressive performances contained larger expressive timing measures and bell movement. Clarinetists marked phrase boundaries with increases in both expressive timing and clarinet motion. Neither pitch height nor sound intensity accounted for bell movements beyond expressive timing. These findings suggest that ancillary bell gestures are rule-governed and correlate with some acoustic features of musical expression.

MEMORY AND PERFORMANCE

Memory for tactus and musical tempo: The effects of expertise and speed on keeping time

Philip Fine and Stephen Bull

The ability to keep time and remember speeds is important in musical performance. Eight musicians and eight non-musicians heard a metronomic beat at three musical speeds—35, 110, and 185 beats per minute (bpm)—and clapped in time to it as accurately as possible. They were then asked to recall the three speeds by clapping alone. After an-

other set of trials clapping to the metronome, they recalled the three speeds once again. Results showed that the participants tended to clap too slowly for the 110 bpm and 185 bpm tempi and that the medium speed was less accurately remembered than the slow or fast. There was no effect of musical experience, but there was a trend of better recall of speed on the second than the first recall trial.

Moving backwards and forwards in time: Recalling dance from long-term memory

Catherine Stevens, Jane Ginsborg, and Garry Lester

Recalling complex non-verbal motor sequences, such as contemporary dance, provides insights into cues and associates in long-term memory (LTM). Four dancers recalled material that they had not performed for between 3-31 years; they initially recalled the material in silence, although the material had been associated with particular musical excerpts. Eight exercises were recalled either immediately or after an unfilled delay and using self-motion or a mannequin. Recall was greater when immediate rather than delayed; self- versus mannequin-motion had little impact on the length of material recalled. Qualitative data indicated that music and dancer movement were important cues to LTM, transitions were sometimes forgotten, and images associated with movement recall were kinesthetic, verbal, visual, and auditory. The results suggest an interplay of procedural and declarative knowledge and activation of multimodal images.

Memory span in dance: Influence of age and experience

Sofia Carvalheiro and Luís Xarez Rodrigues

The retention and recovery of movements are capacities that characterize and determine the life of dancers and dance students. The application of certain memory strategies is necessary and leads to an improvement in motor performance. Usually, the lowest levels of retention are associated with younger dancers when their performances are compared with the oldest and more experienced in dance. We aim in this study to evaluate capacity of the short-term motor memory of children and adults, with and without experience in dance, when asked to reproduce immediately (after presentation) sequences of movements. Results show that experience is crucial when comparing the maximal number of actions and sequences recalled in the correct order. For these same variables, children show lower results than adults, but these differences are not significant when we compare children with experience with adults without experience.

Graduate Award Paper

Fast feedforward error-detection mechanisms in highly skilled music performance

María Herrojo Ruiz, Hans-Christian Jabusch, and Eckart Altenmüller

Expert performance in music or sport requires the ability to monitor ongoing behavior, detect errors *in advance*, and modify the performance accordingly. In this context, errors have dramatic consequences, such as playing the wrong note in a piano concert or mis-hitting a smash during a tennis match. Detection and correction of errors in advance is possible due to the fast functioning of the self-monitoring system. Surprisingly, only sparse evidence about error monitoring has been published in the music domain. Consequently, the present study investigated the electrophysiological correlates of predictive (feedforward) error detection and action control during piano performance. Pianists had to retrieve memorized music pieces at a fast tempo in the presence or absence of auditory feedback. Only wrong pitches were considered as erroneous actions. The main outcome was a negative component elicited around 70 ms prior to errors in the event-related potentials and which is generated by the anterior cingulate cortex (ACC). This component was independent of the auditory feedback and was assumed to reflect error detection processes. Moreover, an interaction between the ACC and the lateral prefrontal cortex predicted corrective mechanisms. The findings presented here shed new light on the neural mechanisms of feedforward motor control.

Abstracts
Thursday, 17 December 2009

Keynote paper

A balanced approach to excellence: Life-skill intervention and elite performance

Deidre Anderson

To become an elite performer in the modern world, individuals must discipline themselves to train and practice for many years. Usually they need to dedicate most of every day in pursuit of their dreams. More and more countries have been developing systems to identify this talent very early in life and are finding new ways to nurture it. The challenge faced by most elite performers is how to manage this intense focus and still build a resilience and capacity to meet the many transitions and demands required in both elite performance and life. These skills are more often than not under developed as a result of the myopic environment typically created for the elite performer. One of the most challenging transitions often faced is retirement. The basis of much research in this area has been undertaken in sport (Alison and Meyer 1988, Baillie 1993, Blann and Zaichkowsky 1989, Blinde and Greendorfer 1985, Lerch 1984, Lavallee *et al.* 1997). Other performance environments such as dance and music have also captured the interest of researchers (Davidson and Burland 2006, Burland and Davidson 2004, Patton and Ryan 2000, Saposnek 1995, Patton and McMahon 1999, Wallach 1988). This growing body of literature has led to some performance environments introducing early intervention programs to broaden the life-skills of the performer. The belief is that this will protect them from the uncertainty and anxiety about their futures and will result in fewer traumas when they have to deal with the transition from elite performance.

Poster Session

Memory consolidation in musicians: The effects of sleep, interference, and recall on musicians' performance of a keyboard melody

Sarah E. Allen

Procedural memory consolidation has been shown to enhance a variety of perceptual and motor skills during sleep, but only recently has this effect been investigated in trained musicians performing music. I tested the extent to which a music performance skill improves over a night of sleep and whether the consolidation process is inhibited when musicians learn two melodies in juxtaposition during a single training session. Fifty-five participants learned to perform either one or two 13-note piano melodies during an evening training session and were retested on the target melody the following morning. Participants showed evidence of overnight performance gains in performance speed and accuracy; however, learning a second, similar melody seemed to block these overnight gains in the melody learned first. These results indicate that experienced learners performing a familiar type of task, and one that includes auditory processing demands, benefit from overnight consolidation of procedural memories but that these benefits may be inhibited when musicians learn similar, competing tasks in juxtaposition.

Health and wellbeing education in British conservatoires

Louise Atkins

Musicians' health and wellbeing is rapidly becoming an essential component within the training of aspiring musicians all over the world. At the forefront of tackling these issues are educational institutions, with conservatoires in particular leading the way in creating educational programs that promote the ideal of a sustainable technique and lifestyle for the professional musicians of the future. Strategic frameworks for health and wellbeing education are beginning to develop in other countries as national strategies. However, development in British music schools is not so cohesive, and each institution takes a different approach to the delivery of their health and wellbeing provision. This project investigates current health and wellbeing education programs on offer in British conservatoires and presents the students' view of this area of their education. In this investigation, a wide range of health and wellbeing activities were revealed, with conservatoires showing support to students through a variety of activities, from practical classes to research opportunities. However, despite this extensive range of services, a high proportion of students revealed that they felt their institution was not providing adequate support for their health and wellbeing, stating that they would like a more proactive approach.

Evidence of noise-induced hearing loss among orchestral musicians

Bradford C. Backus and Aaron Williamon

An assessment of hearing thresholds among student orchestral musicians was carried out at the UCL Ear Institute in conjunction with the Royal College of Music (RCM). Audiogram data taken from 162 students (86 F, 76 M; mean age=23.7 years, SD=4.8) showed a statistically significant notch at 6 kHz in the left ear, indicative of noise-induced hearing loss (NIHL), but no significant notch was found in the right. Noise exposure asymmetry did not appear to account for notch asymmetry as trombone and trumpet players showed evidence of the same left notch trend as lateralized instruments such as violin and viola players. The earliest audiometric indicator of impending NIHL for musicians may be a developing hearing threshold notch at 6 kHz in the left ear.

Strategies for the pianist to enhance the artistic quality of piano recording

Marija Bajalica and David Lockett

The dream of every pianist is to perform in an environment that enables a work to unfold naturally and effortlessly. This, however, does not happen often. Much less so in a studio environment where, compared with the regular concert setting, we have to consider additional sets of issues related to the process of recording in order to achieve a recorded result that meets as closely as possible the player's artistic intentions. This paper suggests some of the strategies that proved to be effective in enhancing the artistic quality of a piano recording.

Analyzing and representing Transylvanian village music by using motion capture

Filippo Bonini Baraldi, Emmanuel Bigand, and Thierry Pozzo

Techniques based on motion capture can be useful to analyze and transcribe a foreign musical system: Transylvanian village music. Two musical parameters were the object of study: rhythm and desynchronization between two performers, a violinist and a viola player. Results showed that rhythm is a local variant of the *aksak* system and is based on two duration units (S=short, L=long), which respect the formula $\frac{2}{3} < \frac{S}{L} < \frac{3}{4}$. Performances are characterized by large deviations of the S/L ratio from period to period, which have an expressive function. Deviations are related to a swinging interpretation, consisting of a voluntarily desynchronization between the performers.

Studying a score silently: What benefits can it bring to performance?

Anabela Bravo and Philip Fine

Mental practice and analysis can be considered as efficacious and useful for performers, as they help them to develop a mental representation of music. This paper discusses what information in the score is potentially useful in developing performance expertise, and how performers can and do utilize it. First, we are concerned with the process of learning and performing a new score and, in particular, in which stages of this process performers find mental practice and analysis with the score useful. Second, we explore what information can be learned from the score before it is performed, i.e. what sort of cognitive representations the performer can obtain from the score. Third, we ask how performers can organize and use that information, i.e. the benefits of mental rehearsal in the attainment of performance excellence. These questions will be addressed through the statements of psychologists, teachers, performers, and musicologists in the relevant literature.

The learning cultures of performance: Applying a cultural theory of learning to conservatoire research

Rosie Burt-Perkins

As educational institutions that play a role in the training of many performers, conservatoires have increasingly become the focus of research. Researchers have explored the one-to-one lesson context, identified and tested means of achieving musical excellence, and worked to enhance musicians' health. There remains, though, little research that investigates the conservatoire as a learning site, characterized by a set of interactions between performer, institution, and music profession. Students learning at conservatoires, as well as teachers and researchers attempting to embed new pedagogical approaches or curricula, must negotiate an educational and musical system embedded in years of history: a system that has, in other words, a "learning culture." This paper explores the central tenets of learning culture as a theoretical approach, arguing that conservatoire research could benefit from a lens that views learning as inherently cultural. The methodological implications of learning culture are discussed, including the need for qualitative methods that seek interpretive understandings and in-depth, rich data. The paper concludes by offering impli-

cations for the application of learning culture within the field of performance science, addressing Jørgensen's (2009) call for increased research on the institutional culture of conservatoires.

Musical narrative deconstruction: Ritual and transgression

Sara Carvalho and Helena Marinho

Envisaging musical narrative as a sequence of ritual structures, this research lies on the concepts of ritual, transgression, and narrative as applied in a case study of a musical theatre piece, *Sound Bridges*. In traditional musical narrative, the focus is on construction, and one could speak of fields around which hierarchies, systems, and rules of musical language are built. In this piece, we find unpredictable transgressive musical gestures, acted out by performers, combined with conventional narrative procedures, as successive musical suspensions in the piece generate pauses in the musical discourse. This research aimed to demonstrate that the concepts of musical narrative and ritual dimension cannot be seen as isolated objects but as entities of transformation by composers, and how the trilogy composer/performer/listener (audience) is associated with narrative and ritual. Ritual and transgression can thus be linked to traditional concepts of musical narrative connecting composing, performing, and listening activities. The concept of ritual can be successfully manipulated by the composer and the performer, particularly in the context of contemporary music. Transgression of ritual, as planned by the composer, can act as a deconstructive factor; as mediators, performers take a crucial role in the process.

The piano repertoire preparation: A research method as a potential tool for reflective instrumental practice

Regina A. T. dos Santos and Liane Hentschke

This paper presents a qualitative research method that was constructed to investigate how undergraduate piano students at different stages of their academic education prepared their repertoire during an academic semester. Three undergraduate piano students—a first semester, fifth semester, and eighth semester students—were followed during an academic semester using a phenomenological approach. For each of the three case studies, three data collection stages took place: the presentation interview, the observation of the repertoire under preparation, and finally, the observation of the student's recall of his own study process. Four complementary research techniques were employed: the semi-structured interview, observation of the performance of the music pieces, a non-structured interview about the repertoire under preparation, and a recall stimulated interview, in which the student reflected about his own performance recorded in video and audio in the previous sections. During the data collection, the methodology gave the undergraduate piano students the opportunity to develop reflective thinking. Instrumental and verbal testimonies have shown that the interviews afforded the students moments to show their thoughts and actions about their piano repertoire preparation. The students acted as active agents in their piano practice, demonstrating awareness of their weaknesses and strengths through self-knowledge.

The role of the soft palate in woodwind and brass playing

Alison Evans, Bronwen Ackermann, and Tim Driscoll

Expired air provides the basis for sound production for musicians playing a wind instrument. This air stream must be controlled and directed into the mouthpiece of the instrument via a reed mechanism at the mouth. To be able to do this, firm velopharyngeal closure is required to prevent air leaking out through the nose from the oral cavity. In some musicians impairment of soft palate function may result in this air leak occurring, which is known as velopharyngeal insufficiency (VPI). A review of the functional anatomy of the soft palate and how it relates to wind and brass playing is discussed with a brief review of VPI as it is reported in musicians. A better understanding of the soft palate anatomy will assist students and music teachers to optimize their performance and prevent performance related medical problems.

The Vincenzo Vitale piano school: Famous school but little known

Viviana Nicoleta Ferrari

This paper introduces some aspects of the Vincenzo Vitale piano school; a twentieth century Italian school generated from the intersection of the Neapolitan piano school and other European musical realities. Although the School is recognized to be important by many, there is very limited specific literature about either the School or Vincenzo Vitale (1908-84). The thesis entitled *The Piano Teaching of Vincenzo Vitale*, undertaken toward the completion of a Bachelors degree and specialization at the University of Bologna in 2005, is still to my knowledge the only in-depth

scholarly study on the topic so far. The focus of the thesis was on the principles of Vitale's teachings, his theories, the formulation of these theories, and their background.

Expertise in cryptic crossword performance: An exploratory survey

Kathryn Friedlander and Philip Fine

This paper investigates the link between practice and level of expertise in cryptic crossword solvers. A survey was conducted of 241 expert solvers, which established that, even among crossword experts, the range and frequency of cryptics solved and the time spent upon this varied greatly. The link between practice and level of expertise was therefore not straightforward, but seemed to be connected to the primary focus of the solver—whether they aimed to “speed-solve” or solve “advanced cryptics” of exceptional difficulty. A brief review of motivational drivers for solvers of cryptics is also included.

Relationship between playing strategy and surface electromyograms in playing drums

Takuya Fujisawa, Naoki Iwami, Masafumi Kinou, and Masanobu Miura

Skills in controlling drumsticks correctly are required to play rhythms without making any mistakes at suitably dynamic levels of sound. Results obtained by analyzing drummers' movements using visual information, such as motion capture or camera recordings, have been reported in past studies, but analysis using biological information has been the focus of fewer studies. To play rhythms without making mistakes at suitably dynamic levels of sound throughout a piece of music, trained drummers are assumed to use different playing strategies: a short-term playing strategy (e.g. every stroke) and a long-term playing strategy (e.g. every piece of music). The aim of this study was to investigate the relationship between trained drummers' playing strategies and muscle movements by recording their surface electromyograms (EMGs) when playing the drums. Three trained drummers and three non-drummers participated in an experiment to record their surface EMGs when playing single-strokes. As a result, it was confirmed that trained drummers play the drums under both short-term and long-term playing strategies.

Between hedonism and atomism: Discrepancies in the performers' musical perception

Veronica Gaspar

The performer's double hypostasis—receiver and music maker, not just transmitter—entails different approaches, sometimes acting divergently, as well at the global level as at the sub-compounds of the musical text. Music is perceived mainly through its supra-segmental level, while the performance routine calls for a syntagmatic approach at a strict phonemic-morphemic level. Over the technical relationship between sounds, the Western music performer has to build the emotional expression through logic unities equivalent to words of a discourse undergoing several temporal and spatial hypostases on the way from the composer to the last participant of the musical process, the listener. Numerous trials aiming at an objective analysis comprise, beside traditional musical structures, also *ad hoc* “meaning units” extracted from imagery, memory cues, or gesture. However, the internal holistic representation of the Western performer is contradicted by both the concrete steps of his practical action and the detailed analytical features. This research tries to identify those musical “ideas” susceptible to play the role of intermediate links between perceptual meaning units and concrete gesture. An attempt aiming at bringing nearer analysis and living performance not only unifies the segmental elements, but ensures a necessary “space” for their psychological resonance.

Effect of music in a healing room for recovery from mental fatigue: A psychological experiment of the relation between relaxing music and listening space design

Yasuhiro Goto

Two experiments were performed in order to examine an interaction of relaxing music and listening space design. In Experiment 1, two types of music were prepared, and a change of room evaluation was investigated. The background music (BGM) used was either relaxing or non-relaxing. Participants were asked to rate the degree of harmony between music and room interior design. The results showed that (1) relaxing music was judged more appropriate for room interior design than non-relaxing music and (2) the room interior design was estimated as more calm when the BGM was relaxing. In Experiment 2, the change in the impression and the likes and dislikes concerning this room were examined by using two types of lighting: calm lighting and ordinary lighting. Sixty participants were asked to rate the impression concerning this room. The results showed that (1) the change in the impression from the lighting did not change the atmosphere formed by the interior design and (2) the good impression of the room improved when the calm lighting was used. This study showed that BGM, as well a room acoustics and lighting, can play an additional role in a highly-designed indoor room.

Performing proportion: Crux awareness in Scarlatti interpretation

Nancy Lee Harper, Tomás Henriques, and Rosalind Halton

This study aims to determine if crux occurrence in Scarlatti's K. 159 sonata conforms to a *golden section* or other proportionate position as found in other sonatas and, if so, is interpreted thus by performers.

Piano playing skills in a patient with frontotemporal dementia: A longitudinal case study

Sharpley Hsieh, Eneida Mioshi, Felicity Baker, Olivier Piguet, and John R. Hodges

Patients with dementia, such as Alzheimer's disease, can continue to play the piano skillfully despite profound cognitive impairment. It has been suggested that this may be because these skills have been well-rehearsed and become automatic motor movements. Less is known about how these musical skills may be related to the performance of everyday functional abilities and, also, how the ability to play a musical instrument may be affected in other dementia types. Recordings of a patient diagnosed with behavioral-variant frontotemporal dementia, a dementia syndrome clinically characterized by marked behavioral and cognitive changes, playing the piano was taken 12 months apart. Aspects of musical performance (accuracy, tone quality, dynamics, rhythm, tempo, and interpretation) were rated by professional musical teachers. The physical and mental skills required to complete activities of daily living were assessed. Tests of cognitive functioning and brain imaging were also conducted over this period. Results showed that over one year, significant declines were observed in the areas of cognition, the mental abilities required for everyday skills, as well as brain atrophy on imaging. Physical skills for the performance of activities of daily living were relatively preserved, as was the ability to play the piano. These findings confirm previous reports and demonstrate the relative independence of procedural skills in the context of significant cognitive impairment in patients with dementia.

Chin force in violin playing

Hiroshi Kinoshita and Satoshi Obata

The aims of the present study were to develop a chinrest that could directly assess chinrest force during musical performance and to provide baseline force data. A force transducer-mounted chinrest was designed and built by the present authors. Data were obtained from 11 elite violinists while they performed scale tasks at different dynamics (*p*, *mf*, and *f*), tempi (1, 4, and 8 Hz), and hand positions (first and eighth). Data were also obtained from playing the tasks with vibrato, and the excerpts were from the Bruch and Dvorak concertos. A mechanical test of the chinrest confirmed good linearity of the force up to 100 N. During the scale tasks, chinrest force was around 14 N at *p*, which increased to 18 N at *f*. Neither the playing tempo nor the hand position largely affected the force, but it was significantly increased during vibrato. During playing the Bruch concerto, the force was elevated to 28 N (peak force=39 N; the peak-force range in all players=26-76 N). Typical chinrest force to stabilize the violin during ordinary musical performance is thus less than 20 N, but it can be tripled or more when performing technically demanding musical tasks.

The nature of professional accompanists and their roles:

Performing with musical excellence and enjoying communicative interaction

Yuriko Kubota

The aim of this paper is to explore the traits and roles of professional accompanists. This study is based on an internet survey. Professional accompanists were asked to complete a questionnaire through an internet website. The participants (n=96) identify themselves mainly as being sensitive, thoughtful, logical, and optimistic. At the start of rehearsal, accompanists generally try to establish a collaborative tempo and timing while seeing the big picture of the music. At the end of rehearsal, they concentrate on mood/feeling, dynamics, and aesthetic goals much more than at the start. Although some insist that accompanists should follow the soloist's expression, most accompanists enjoy and expect communicative musical activity within music. Expert accompanists point out that they have an important role in making music that is better than that created by the soloist him/herself. It would seem that professional accompanists should have an ability to perform with an overall structure of music with confidence from the very start of rehearsal. Furthermore, it is likely that particular techniques for accompaniment, including practical communication skills (social, physical, and musical), with flexibility and artistic excellence, have considerable influence on their work.

How memory fades: Very-long-term recall of Bach

Tania Lisboa, Roger Chaffin, and Topher Logan

A cellist memorized the *Prelude* from J. S. Bach's *Suite No. 6* for solo cello and identified performance cues (PCs) that she attended to in performance. During the next three years, she recalled the piece twice, playing and writing out the score from memory on both occasions, in counterbalanced order. Played recall was better than written recall. Written recall was better at expressive and structural PCs, suggesting that these cues provided content accessible access to declarative memory. Written recall was worse at PCs for basic technique but less so when written recall followed played recall. In written recall, serial cuing was impaired by the absence of sensorimotor cues, particularly at basic PCs. These directed the cellist's attention to her actions. Reinstating sensorimotor memory by playing through the piece reduced the impairment caused by the absence of these actions during written recall.

What do children think of music teachers? Their conceptions about cello teaching and learning

Guadalupe López, J. Ignacio Pozo, and Alfredo Bautista

We present an exploratory study about the conceptions held by basic level conservatory students about what they think of cello teachers and how different teaching strategies could improve their learning skills, focused on the educational-evolutionary variable. In this research, twelve Spanish children participated, and they were evenly in four different grades of basic level in Spanish conservatories. The main aim of this study was to describe, from a qualitative perspective, the different conceptions about cello teaching and learning. This project helped to develop and test the goodness of the materials, tasks, and criteria of analysis needed. Data were collected through a structured interview, which contained questions and tasks on five different studios related to teaching and learning musical instruments. It seems that children come with constructive ideas to the music lessons, but when they receive instruction, these ideas disappear gradually. Theoretical and educational implications suggested by the findings of this investigation are discussed.

The use of musical scores in order to perform: An exploratory study with flute players

Cristina Marín Oller, Puy Pérez Echeverría, and Susan Hallam

Sixteen flute students at two levels of expertise from conservatories in Madrid participated in an individual semi-structured interview designed to explore the activities they carry out when they learn a new piece of music, as well as the elements of the musical score that they work on. The learning process was divided into three stages: beginning, middle, and end. Twelve categories of analysis were developed and chi-square was used. Differences in responses were noted between the students at each level of expertise for each stage of practice. Findings are discussed in relation to previous research in development of musical expertise.

Pirouetting with pain: Attitudes surrounding female ballet dancers dancing with pain

Rosemary Martin

While female dancers performing classical ballet are expected to present an image of effortless grace, the actuality is often a much more painful experience. The current study examines questions related to this experience: what do dancers understand pain to be, why do they dance in pain, when should they stop dancing in pain, and how do they ultimately communicate this pain to others? This ethnographic research collects the views of current dancers, ex-dancers, dance teachers, choreographers, and artistic directors through in-depth individual interviews. The collected interviews are analyzed using Foucauldian perspectives of discipline, social hierarchies, power, knowledge, and discourse, along with feminist theory, prevalent physiological conceptions of pain, and contemporary theories of dance pedagogy, ethnography, and subjectivity. It is revealed through the interviews that pain is often a part of the dancer's life, a close acquaintance constantly watching over the dancer's shoulder. Pain is also seen to be instigated, influenced, and reinforced by the aesthetics, technique, institutions, and culture of ballet. The collected narratives demonstrate the highly subjective nature of pain and that the balletic environment still embrace a "no pain, no gain" mentality.

Cardio-respiratory responses to expressiveness in piano performance

Hidehiro Nakahara, Shinichi Furuya, Satoshi Obata, Peter R. Francis, and Hiroshi Kinoshita

This study examined selected autonomic and cardio-respiratory responses of nine pianists during solo performances of the same single musical piece. The subjects performed the piece with and without self-perceived emotional expression, and with and without free ancillary body movements during expressive performance. Autonomic nervous sys-

tem and cardio-respiratory parameters were continuously monitored during all experimental conditions. These parameters were heart rate (HR), sweating rate, the root mean square of successive difference (RMSSD) of heart rate variability, and respiratory measurements such as oxygen consumption (VO_2), minute ventilation, tidal volume, and respiratory rate. Kinematics of the trunk and arms were recorded during all conditions. The expressive condition had significantly higher levels of HR, sweating rate, minute ventilation, and tidal volume, and lower levels of RMSSD and respiratory rate than the non-expressive condition. No difference was found for VO_2 between these conditions. The expressive condition with ancillary body movements did not significantly differentiate any of the physiological measures except for respiratory rate from those without such body movements. These findings suggested that expressive musical performance could modulate the emotion-related autonomic and cardio-respiratory responses that are independent of the effect of physiological load due to expressive ancillary body movements in playing the selected music on the piano.

The Listening Gallery: Integrating music with exhibitions and gallery displays

Giulia Nuti, Ashley Solomon, and Aaron Williamon

The Listening Gallery is a collaboration between the Royal College of Music (RCM) and the Victoria and Albert Museum (V&A), the UK's National Museum of Art and Design. Stemming from recent research in music, art, design, and technology, the project connects objects in the V&A's collections with music that shares their rich and distinctive pasts. Specifically, new and existing recordings of music have been integrated into the V&A's spring 2009 exhibition, *Baroque 1620-1800: Style in the Age of Magnificence*, and into the museum's newly renovated *Medieval and Renaissance Galleries*. The impact of the project has been far reaching, as a novel approach to music in museums is achieved: the choice of pieces is underpinned by musicological research, performance follows the practices of the time, the instruments used are originals or faithful copies, and the provenance of the pieces is described. This article focuses on four new recordings that were made for the project. The objects with which the music is associated are briefly described, the connection with the music is explained, and details of the recorded pieces are given.

Difficulty of violin vibrato in novice players: Fingerboard reaction force analysis

Satoshi Obata, Hidehiro Nakahara, Takeshi Hirano, and Hiroshi Kinoshita

The aim of this study was to investigate the difference in the nature of shaking (the longitudinal and lateral components) and press (the vertical component) forces during the production of a vibrato tone by 10 novice players as compared with 10 expert players of the violin. A violin installed with a 3-D force transducer was used for the measurement of the force while performing a successive A (open) and D (vibrato and force measurement) tone production task for 30 s at 4.5 Hz vibrato rate at *mf* (75-77 dB). The index, middle, ring, and little fingers were used for the measurement. The average, amplitude, and peak-to-peak time of shaking and press forces were evaluated for each trial data. The results indicated that the intra-individual variability of the amplitude of shaking force and its peak-to-peak time for all fingers was significantly larger for the novices than the experts. The novices had smaller mean values of shaking and press forces than the experts, and this group difference was larger for the index and little fingers than for the other fingers. Novices have been believed to use a grip too firm to shake the hand. The present data suggest that it is the opposite.

Musical learning and cognitive performance

Carlos Santos-Luiz, Daniela Coimbra, and Carlos Fernandes da Silva

According to literature, there are broad associations between music and cognitive abilities, which apparently result from the frequency of music lessons. The aim of the present work was to test these associations between a group of music students and a control group of students with no music education, thereby contributing toward understanding the link between music learning, intelligence, and academic achievement. The Battery of Reasoning Tests (BPR/7-9), collated for the Portuguese population, as well as the academic classifications of two groups of students, provided the basis for this study's quantitative analysis. The sample population comprised students who frequented Year 7 of the basic music course in specialist music education and of the basic course in mainstream education (no music lessons). Compared with the students in the control group, those in the groups which included formal music education showed increases in their general capacity of reasoning (g factor) and in tasks of spatial and numerical reasoning. Equally, there were increases in academic achievement. The results suggest that the duration of exposure to music lessons is associated with an increased intelligence and increased academic achievement.

**A longitudinal observation of one-to-one singing lessons:
The effects of personality and adult attachment***Sofia Serra-Dawa*

Instrumental and singing teaching has previously been studied with particular focus on pedagogical, cognitive, technical, and developmental aspects. However, the relationship and interactions that take place between the teachers and students in that setting deserve more extensive exploration. This study approaches the singing teacher-student relationship with a particular focus on the observation of personality traits and the levels of attachment identified between teacher and student. Eleven singing teachers with 54 students were observed in one-to-one singing lessons through video observations made during one academic year. Additionally, teachers and students completed the questionnaires NEO FFI-R and Adult Attachment Scale to evaluate personality and attachment. The interaction between teacher and student include a wide list of variables: personality combination, the individual background, kind of attachment felt toward each other, and many other singing aspects, suggesting that the relationship with the student could have major impact on other aspects of singing.

Emotional lingering: Facial expressions of musical closure*William Forde Thompson, Rachel Bennetts, Bojan Neskovic, and Caroline Palmer*

We report evidence that singers maintain emotional facial expressions after vocalization has terminated, introducing a form of emotional lingering. Emotional lingering extends and complements acoustic signals of emotion, providing a visual signal of musical closure. We first describe evidence from production studies that emotional facial expressions continue beyond the acoustic dimension of music. We next describe evidence that perceivers are sensitive to facial expressions that occur beyond the production of sound, and that such signals carry reliable emotional information. We note that audiovisual experiences of music are compatible with current understandings of multisensory integration in the central nervous system. As such, investigations of performance should include consideration of facial expressions and other performance gestures.

Pianists with carpal tunnel syndrome: Conservative versus surgical treatment*Hara Trouli and Nikos Reissis*

We studied retrospectively 18 patients, all professional pianists or advanced piano students, who had presented with carpal tunnel symptoms in the past and had undergone surgical or conservative treatments. We found that delayed diagnosis was more likely to lead to surgical treatment and that fear of diagnosis and fear of surgery prevented early treatment. Although surgical release was successful in 50% of the patients, re-education was essential to maintain good results according to long follow-up. Finally, medical practitioners are in a better position to help pianists when they make consideration of the demands and technical peculiarities of this profession.

Musical training facilitates brain plasticity: Short-term training effects on sensorimotor integration*C. Carolyn Wu, Vanessa K. Lim, Jeffrey P. Hamm, and Ian J. Kirk*

Efficient sensorimotor integration is essential for music performance. Previous research has indicated that auditory-motor associations form not only as a result of long-term training but after a very brief period of training. After short-term training, it has been demonstrated that pre-motor areas are recruited during passive listening of trained music, suggesting that these mappings can rapidly become automatic. It has been argued that these mappings rely on activity in mirror neuron systems (involved generally in imitating and learning actions). Action-observation studies in this field have associated changes in EEG mu-rhythm activity with the mirror neuron system. We utilized this technique in our action-listening study in order to detect involuntary motor co-activation during passive listening to melodies and rhythms. We investigate whether motor co-activation during passive listening occurs specifically for newly acquired sound-action mappings after training. Subjects participated in a short-term training scheme in which they were trained to accurately play back randomly generated basic piano melodies. Preliminary results show changes in the mu-rhythm activity in post-training EEG recordings. These initial findings support the hypothesis that sensorimotor experience is important for the mirror neuron system. This study demonstrates that musical training research can make a valuable contribution to brain plasticity research.

Thematic Sessions

SYMPOSIUM:

MUSICIAN'S DYSTONIA:

NEW ASPECTS IN PATHOPHYSIOLOGY AND TREATMENT

Is musician's dystonia an inherited condition?

Alexander Schmidt, Hans-Christian Jabusch, Eckart Altenmüller, Johann Hagenah, Rachel Saunders-Pullman, Susan B. Bressman, Alexander Münchau, and Christine Klein

Musician's dystonia (MD) is generally considered a sporadic disorder that presents with loss of voluntary motor control of extensively trained movements. To test the hypothesis of a genetic etiology in at least a subset of MD, we initiated a large clinical genetic study. The families of 28 index patients with MD, 14 with a reported positive family history of focal task-specific dystonia (FTSD) and 14 with no known family history (FH-), underwent a standardized telephone screening interview using the Beth Israel Dystonia Screen. Videotaped neurological examinations were performed on all participants who screened positive, and consensus diagnoses were established. All patients were investigated for the GAG deletion in DYT1; suitable families were tested for linkage to DYT7. A diagnosis of dystonia was established in all 28 index patients and in 19 of 97 examined relatives (MD: n=8, other FTSD: n=9, other dystonias: n=2), 5 of whom were members of FH- families. In total, 18 families were multiplex with 2-4 affected members. The GAG deletion was not present in any of the tested patients. Linkage to DYT7 could be excluded in one of the 11 informative families. Our results suggest a genetic contribution to MD with phenotypic variability including FTSD.

New aspects in action planning and execution in musicians with dystonia

María Herrojo Ruiz, Hans-Christian Jabusch, and Eckart Altenmüller

Recent neurophysiological studies have associated focal-task specific dystonia (FTSD) with impaired inhibitory function. However, it remains unknown whether FTSD also affects the inhibition (INH) of long-term overlearned motor programs. Consequently, the question whether or not musician's dystonia (MD) affects the inhibition (INH) of long-term overlearned motor programs was addressed. By means of electroencephalography (EEG), the neural correlates associated with INH of long-term overlearned motor memory traces were investigated in MD and healthy pianists in a Go/NoGo paradigm. The findings support the hypothesis of a deficient phase coupling between the neuronal assemblies required to inhibit motor memory traces in patients with MD. Furthermore, in NoGo trials, the movement related cortical potentials showed a positive shift after the NoGo signal related to inhibition and was significantly smaller over sensorimotor areas in musicians with MD. Lastly, EMG recorded from the right flexor pollicis longus muscle confirmed that patients with MD had a disrupted INH in NoGo trials.

Functional and morphological changes of brain structures in patients suffering from musician's dystonia

Eckart Altenmüller, Oliver Granert, Martin Peller, Hans-Christian Jabusch, and Hartwig Siebner

Focal hand dystonia has been associated with morphometric changes and distorted somatotopic representations in the putamen. Our objective was (1) to test for morphometric alterations of the putamen in pianists with musician's dystonia (MD) relative to healthy pianists without dystonia and (2) to identify structural changes in the basal ganglia that correlate with performance during piano playing. Eleven pianists with MD and 12 healthy pianists without dystonia underwent high-resolution T1-weighted MRI of the whole brain. Additionally, motor performance was investigated in a music-related task according to a protocol previously described as a valid and reliable method to assess motor control in pianists. When playing major scales on the piano, the timing of key strokes was more variable in patients with MD than in pianists without dystonia. Healthy musicians had a smaller grey matter volume in the right middle putamen compared with MD patients. In dystonic and non-dystonic pianists, the middle part of the left and right putamen was smaller in individuals with higher temporal accuracy during piano playing. A smaller associative territory of the motor putamen is a structural marker for manual skillfulness in highly trained pianists. Since this structure-function relationship is preserved in MD, we argue that the relative increase in grey matter volume in this region reflects impaired performance in dystonic musicians rather than a specific structural substrate of focal hand dystonia.

Setting the stage for prevention and treatment: New therapeutic approaches in musician's dystonia

Hans-Christian Jabusch, Franziska Buttkus, Volker Baur, Maricruz Gomez-Pellin, Laurent Boulet, and Eckart Altenmüller

Musician's dystonia (MD) is probably the most challenging disorder in musicians' medicine. It has a tremendous negative impact on the careers of affected musicians and is difficult to treat. We have investigated treatment effects of established therapies and new approaches on playing-related motor control in pianists with MD.

The effects of pianistic retraining via video conferencing as a means of assisting recovery from focal dystonia: A case study

Rae de Lisle, Dale Speedy, and John Thompson

Focal dystonia (FD) is a devastating neurological condition that can result in the loss of a musician's playing ability. In pianists, involuntary muscle contractions can cause abnormal finger postures, making it impossible to play at concert level. It is a difficult condition to treat, and although some improvement has been reported with Botulinum toxin therapy, complete recovery is rare. Our study investigated whether retraining with the aid of video conferencing could be helpful in the treatment of a professional pianist resident in the UK with a six year history of focal dystonia. Quality of scales was assessed before and after pianism retraining and included assessment by a listener blinded as to which hand was dystonic and whether they were assessing playing pre- or post-retraining. Although full recovery was not seen, improvement was observed at slow tempi and the hand was visibly less cramped as training sessions progressed. We conclude that video conferencing could be an acceptable medium for pianistic retraining in pianists with FD when location prevents onsite retraining. However, in this study it did not seem as effective as one-to-one retraining in the same location.

UNDERSTANDING PERFORMANCE

Doing without thinking? Aspects of musical decision-making

Daniel Bangert

When asked to explain their processes of musical decision-making, musicians attribute their behavior to various causes. This paper explores how musical decisions are made. A semi-structured interview was conducted with a Baroque violinist about her interpretation of the violin line in the aria *Ich bin vergnügt in meinem Leiden* from J. S. Bach's Cantata BWV 58. Using interpretative phenomenological analysis (IPA), the interview was coded to create categories describing differing influences on the performer's musical interpretation: feelings, score analysis, research, technical considerations, and specific experiences. A second analysis identified intuition and analysis as contrasting approaches to musical decision-making. This paper focuses on the nature of intuitive methods of making interpretative choices with reference to the interview data and psychological literature on intuition.

Applications of formal analysis: Musical comprehension and memory consolidation in performance

Elena Esteban Muñoz

This paper reflects principally on the perception of musical form and its dependence on the temporality in front of the conceptual system, related to the nominalizations and numerical groupings of the theoretical representation of the structure. Through the assumption of practice as the only way to experience music, this paper calls for sensations and emotional intelligence with regard to musical appreciation, including form as one of the most important elements of musical comprehension. The capacity of the performers for evoking musical form, through its knowledge synchronically to its temporal experience, is defended as a potential tool for consolidating memory due to the security it provides in performance.

That blissful feeling: Phenomenological conceptions of music performance from one performer's perspective

Andrew Geeves and Doris McIlwain

Inspired by the small amount of relevant past research available (Berger 1999, Berliner 1994, Monson 1996, Sudnow 1978), this paper focuses on the type of performance experience an individual musician views as worthy of striving toward (and avoiding) and the possible way(s) in which this can be accomplished. Using Strauss and Corbin's (1998) take on Grounded Theory (GT) as a methodology, data obtained from a semi-structured, in-depth interview with Jeremy Kelshaw (JK), a professional musician, are examined. JK's subjective, phenomenological experience of music

performance comprised a detailed understanding of an ideal performance which emerged from JK's understanding of excellence and the uniquely uncertain nature of music performance. Also important in this experience were a number of strategies implemented by JK and his band Cloud Control in an attempt to establish, maintain, and regain vibe, the mysterious key ingredient of a desirable performance experience. Alongside the implications it holds for music education, this research also provides a unique insight into an individual musician's understanding of an ideal performance experience and the strategies used to achieve this.

THE PERCEPTION OF TECHNIQUE

Left-hand expression in cello playing: Exploring approaches to shifting

Tânia Lisboa and Fernando Gualda

This investigation explores aspects of musical interpretation in relation to left-hand cello technique. It focuses on how listeners, performers, and teachers approach shifting, both in terms of its functionality and its expressive use in portamenti. The method involved appraisal of five selected interpretations through listening experiments with cellists and other instrumentalists, analyses of portamenti, and interviews. The results revealed that listeners generally preferred contemporary recordings with less obvious use of portamenti and that cellists tended to rate the use of portamenti higher than other instrumentalists.

Fingering force in violin vibrato

Satoshi Obata, Hidehiro Nakahara, Takeshi Hirano, and Hiroshi Kinoshita

This study investigated the spatio-temporal features of the longitudinal ("shaking") and normal ("press") string clamping forces by the left hand during vibrato sound production. A violin installed with a 3-D force transducer was used for the measurement of the force at the D5 tone position. Twelve trained violinists produced an A (open) tone for 2 s followed by a D (vibrato and force measurement) tone for 30 s at different vibrato rates (4.5 and 6 Hz, and no-vibrato), dynamics (*p*, *mf*, and *f*), and with the use of different fingers (index, middle, ring, and little fingers). The average, amplitude, and peak-to-peak time of shaking, and press forces, and the longitudinal-lateral shear force relationship were evaluated. During vibrato, an oscillated pattern was observed in each of the three forces, while the longitudinal component demonstrated the largest periodic oscillation. The average press force and the amplitude of shaking force significantly increased with the rate of vibrato as well as dynamics of the sound generated. These force variables did not differ among the four fingers. The shaking force showed considerable inter-player difference (1.0-4.2 N). The feedback training was found to help in some reduction of the force.

Fluctuation strength of tremolo played on the mandolin: How is tremolo evaluated as good?

Nozomiko Yasui, Masafumi Kinou, and Masanobu Miura

The tremolo played on the mandolin is a continuous sound produced by the repetition of attenuating sounds. The amount of acoustic amplitude of tremolo is usually fluctuated in terms of time. Therefore, the tremolo is assumed to give a listener the feeling of fluctuation, which is thought to be concerned with subjective evaluation for performance proficiency. Introduced here is an evaluation method that strongly depends on the "fluctuation strength" (FS), which has been suggested as an index for evaluating the feeling of fluctuation for fluctuating sounds at low frequencies. Past studies have investigated the index for modulated pure tones and broadband noise. In this study, tremolo fluctuations are described by FS, and the relation between FS and tremolo proficiency was investigated through evaluation experiments. Specifically, we conducted four studies using performance sounds and two kinds of synthesized sounds. As a result, highly rated tremolos had a relatively low physical FS and were correlated with highly subjective evaluations. Therefore, we confirmed that skilled tremolos satisfied both playing restrictions and psychoacoustical criteria.

EMOTION IN PERFORMANCE

The effects of musical syntax on perception of music performance

Katty Kochman, Marc Leman, and Jana DeClerk

The focus of this study is to examine the effects of social interaction and musical syntax in a music performance with emphasis on emotion perceptions. The syntactical elements that were analyzed during the course of these experiments included pitch, tuning, and timing. Two experiments were conducted to examine the relationship of syntax and performance. In the first experiment, subjects were asked to state preference between altered stimuli with higher levels of expressivity and unaltered stimuli with lower levels of performer expressivity. In the second experiment, subjects were asked to sing familiar or traditional songs in social and individual settings. Results confirm that par-

ticipants demonstrated a definitive preference toward social interaction when actively engaged in embodied musical performance. However, the outcome was less definitive in passive listening environment of the first experiment.

Emotional arousal and the automatic detection of musical phrase boundaries

Steven R. Livingstone, Emery Schubert, Janeen D. Loehr, and Caroline Palmer

This study investigated correspondences between listeners' emotional responses to an orchestral work and the underlying phrase structure. An algorithm for the automatic detection of musical phrase boundaries was developed, based on listeners' continuous ratings of perceived emotion with a two-dimensional tool (valence and arousal). Rates of change in arousal (velocity) and change in change in arousal (acceleration) for each musical phrase were combined into a single metric. Similarity in listeners' responses for musically related phrases was higher than those for musically contrasting phrases. Based on listeners' responses to identical sections, a recursive algorithm identified all phrase boundaries. These findings indicate novel measures of change in listeners' emotional arousal that correspond with musical phrase structure.

Communicating emotion in piano performance

Cristina C. Gerling, Regina A. T. dos Santos, and Catarina Domenici

Music expression involves tacit knowledge, an elusive and frequently lacking aspect of music education. This paper considers activities related to learning new repertoire. In a supervised performance lab at the Federal University of Rio Grande do Sul, students gather weekly to play and discuss the results of their practice activities and performances. Building on two previous studies (conducted in 2007 and 2008) wherein students were introduced to Russell's "circumplex model" in order to establish a common vocabulary, they were encouraged to label both intended and perceived emotions. In the present study, we present data on the preparation of a lesser-known piece by Schumann without guidance from their piano teachers. After nine weeks, participants were encouraged to discuss their level of achievement by listening to the results of three recording sessions. Parameters such as contour, articulation, tempo, timing, dynamics, movement/gesture, and global coherence were evaluated in order to assess their performances. Two independent referees also graded the third recording session, and these results were quantitatively and qualitatively compared with those of the students. The results suggest a lack of correlation among the parameters. After two more weeks of practice, there was no significant increase in the level of ability and there was also a low degree of correlation between intended and perceived emotions among participants.

Workshops

Hearing and the noise of performance: Solutions for sound monitoring

Aaron Williamon, Bradford C. Backus, Stephen Dance, and Georgia Zepidou

Performing artists must be able to practice, rehearse, and perform safely. With respect to hearing and the "noise" of performance, however, the delicate nature of their work and the dedication of performers themselves may mean that they—as well as their employers, educators, and managers—are placed in a difficult position when complying with new international noise at work regulations. This workshop showcases recent initiatives that have brought together artists and scientists to generate practical solutions and new technology for monitoring noise and protecting hearing, while having little or no impact on the quality of performers' work. The workshop consists of the following demonstrations: "Improving noise exposure during practice: The sound absorbing mirror" (Dance and Zepidou), "The use of the iPhone as a sound meter: A cheaper noise badge" (Dance and Zepidou), and "The E-meter: A new noise badge designed for the entertainment industry" (Backus and Williamon). In each, new devices and technology are demonstrated alongside in-depth discussion of the research underpinning their development, as well as their cost and application across a wide range of performing arts contexts. The workshop also considers avenues for future research and the artistic, cultural, and scientific requisites that must be met in pursuing them.

Taking microtonal composition and performance from the periphery into the mainstream

Graham Hair, Nicholas J. Bailey, and Lisa Swayne

This workshop seeks to bring some technical and expressive aspects of microtonal singing from experimental approaches (e.g. those represented by the music of Harry Partch) into mainstream vocal performance. *Sacred Song-*

book is a collection of “lieder” by the first author, set to texts of Abrahamic (Christian, Jewish, Islamic) provenance, using the microtonal scale with 19 equal steps to the octave. The third author will demonstrate (live) the preparation for performance of selections, using machine-assisted rehearsal, performance, measurement, and analysis techniques developed by the second author. The workshop will showcase: (1) machine-assisted practice techniques, (2) score-based versus aural-based rehearsing techniques and feedback, (3) post facto empirical (machine-based) measurement, analysis, and interpretation, (4) use of techniques of microtonal melodic ornamentation and gesture to blend expressive and technical means, and (5) the relationship between the meaning, character, and aesthetic qualities of the texts and the musical expression and structure of the performance. The workshop draws on a number of sources from experimental composition and performance traditions, and harnesses, develops, and extends them to invigorate mainstream approaches to vocal performance and to achieve performances that reflect something of the ecstatic mysticism of texts from the different traditions represented in the *Sacred Songbook*.

The art and science of historical performance

Colin Lawson and James Tibbles

Daniel Türk's *Klavierschule* (1789) makes the important observation that “some musical effects cannot be described; they must be *heard*.” Evidence for the art (as opposed to the science) of historical performance remains elusive, deliciously inexact, but potentially inspirational. Clearly, C. P. E. Bach's remarks about the importance of moving an audience are of special value; and no clarinettist can afford to ignore the reviewer who described Anton Stadler's clarinet as having “so soft and lovely a tone that no-one with a heart could resist it.” Modern “period” performers each occupy a position on the spectrum from historical accuracy to practical expediency, not least in their choice of original instruments, copies, or replicas. “Authentic” performers have sometimes denied any form of glorifying self expression, but acted in the service of the composer by following “textbook” rules, with a strictly empirical program to verify historical practices. With no reference to personality, this was somehow magically transformed into a composer's intentions, with the performer dangerously close to infantile dependency. This workshop deconstructs period performances of music for clarinet and fortepiano by Mozart, Stadler, and Vanhal, distinguishing historical elements from those aspects of art and science that are arguably rooted in the twenty-first century.

Abstracts
Friday, 18 December 2009

Thematic Sessions

SYMPOSIUM:

STUDENT MUSICIANS' MOTIVATION, LEARNING, AND PERFORMANCE

Multiple motives: Profiles of young Australians' reasons for musical engagement

James M. Renwick and Gary E. McPherson

Self-determination theory conceives of motivation as lying along an intrinsic-extrinsic continuum and has been investigated extensively in school learning, but less in performance domains. This paper investigates the ways that students manifest multiple motives for striving in the demanding field of musical performance. Performance examination candidates (n=677) aged 8-19 years completed questionnaires. Factor analysis produced five motives lying along the internal-external continuum. Cluster analysis then generated four groups of participants: (1) a group reporting high levels of internal motives and low levels of external motives, (2) a group reporting high levels of all five motives, (3) a group reporting low levels of internal motives and high levels of external motives, and (4) a group reporting low levels of all five motives. Results showed that both groups with high levels of internal motives achieved higher performance results than the two groups with low levels of internal motives. The high-external/low-internal group did not differ in performance achievement from the group reporting low levels of all motives. The study confirms prior research in suggesting that high levels of internalized motives can work together with high levels of external motives to produce excellent performance, but external motives alone are insufficient.

Playing together in ways that cater for and fulfill student musicians' psychological needs

Gary E. McPherson

This study applied Self-Determination Theory to study the psychological needs of a sample of 34 highly involved year 11 and 12 student musicians in a large Midwestern state of the United States who possessed the ability to become professional musicians. Content analysis of survey responses and face-to-face interviews sought to clarify how the psychological needs of relatedness, autonomy, and competence were being met by the musicians' musical engagement in and outside of school. Results demonstrate complex motivational forces in action during this key stage of development. Being around like-minded peers, supportive teachers, and an environment that was conducive challenged them to achieve at a constantly higher level. Many were agonizing with personal and external influences however, which left them with self-doubts about whether they should go on to become a professional musician, whether they would still feel the same way about music in the years to come, and whether they felt capable of obtaining a position in music that would provide sufficient satisfaction for them personally and professionally.

Focus, effort, and enjoyment in chamber music:

Rehearsal strategies of successful and "failed" student ensembles

Jane Ginsborg

Different chamber ensembles take different approaches to individual practice and ensemble rehearsal; in this study, we investigated the approaches of three student groups who could be described as successful and "failed." The members of two string quartets, one newly-formed and one established, and a newly-formed wind quintet kept practice and rehearsal diaries for six months. There were significant differences between what and how they practiced and rehearsed and between their ratings of their own and their colleagues' focus, effort, and enjoyment, although these three dimensions were correlated in several ways. The members of the successful established ensemble enjoyed practicing more than rehearsing, while the reverse was true for the members of the successful new ensemble. It is also clear from the ratings that participants were realistic about the efficacy of their practice and rehearsal strategies. These findings have implications for theories of motivation and practical applications for the teaching of chamber music.

What predicts performance excellence in tertiary level music students?

Dianna T. Kenny, James Fortune, and Bronwen Ackermann

Performance quality should be the dependent variable in studies of music performance anxiety (MPA), as improvement in performance quality, as opposed to greater subjective wellbeing or altered physiological states, is the desired outcome for performing musicians of any intervention to reduce their arousal/anxiety during skilled performance, although the former factors may be necessary to achieve the latter. A predictive model of performance quality was

developed for empirical assessment using tertiary level flute students. Hierarchical regression analyses tested the hypothesis that the specified variables (level of accomplishment on instrument, performance preparation, psychological and physiological measures) would predict expert ratings. The model accounted for 72.8% of the variance in expert ratings. Three variables contributed most—highest achievement as a soloist (0.91), minutes spent practicing the test piece (0.39), and music performance anxiety (0.38). These results indicate that some arousal during skilled performance in skilled performers is necessary to achieve a standard of performance that receives a high rating from an expert listener. Fear of negative evaluation (FNE) had negative beta weights in the predictive equation, showing that FNE is not helpful for skilled performance, as it is likely to distract the performer from the task and introduce irrelevant cognitions that would be likely to interfere with performance. Musical aptitude and achievement are clearly critical factors that are often neglected in models of both performance anxiety and performance enhancement.

PERFORMERS' HEALTH

Influence of musculoskeletal dysfunction and pain on performance excellence

Anke Steinmetz

Playing-related musculoskeletal disorders (PRMD) and pain are a common phenomenon in professional musicians, with a prevalence of up to 80%. A majority of musicians are not aware that pain influences their performance excellence. Recent research data demonstrate that pain has the impact to change motor control strategies. Musicians with pain experience coordination impairments, muscle inhibition, and changes of motor control, influencing their movement patterns while playing their instruments. Vice versa, motor control impairments in musicians with poor body awareness or body control can have an immense impact on the development of musculoskeletal dysfunctions and pain. There is evidence that musicians suffer double the amount of musculoskeletal dysfunctions than non-musicians. Additionally, evidence is growing that the failure of stabilization systems as the feedforward activation of transversus abdominus muscle for the lumbar spine contributes to the development of a chronic pain syndrome. A study at our clinic has provided clinical data demonstrating the dysfunctions in various stabilization systems. Preliminary results of ultrasound investigations of the activation of the transversus abdominus muscle in musicians with musculoskeletal dysfunctions support these findings. This research data suggest an association of the impairment of the lumbopelvic stabilization system with PRMD.

Do pianists play with their teeth?

Sofia Lourenço, Miguel Pais Clemente, Daniela Coimbra, Álvaro Barbosa, and João Carlos Pinho

The aim of this study was to find out whether the masticatory and postural muscles are used by pianists during their music performances. The study also aimed to ascertain whether the complex neuromuscular activity involved in the act of playing the piano also encourages hyperactivity in terms of the masticatory muscles. The bio-electric potentials of the masticatory and postural muscles of 20 pianists were recorded by surface electromyography (EMG). The EMG recordings obtained regarding the temporal and masticatory muscles are much higher than those recorded when in the resting position. These recordings, which are not the same as those obtained, for example, when the individuals are chewing hard food such as a carrot, are nonetheless indicative of daily parafunctional activity in musicians who often study for as much as seven hours per day.

ISSTIP performing arts clinics at the London College of Music 1990-2005: The first ideas, the realization, and the lessons for the future

Andy Evans and Hara Trouli

We take this opportunity of presenting data from the International Society for the Study of Tension in Performance (ISSTIP) clinics in London between 1990-2005. The ISSTIP clinics were multi-disciplinary and were based at the London College of Music. They were founded by Carola Grindea (1914-2009), a piano pedagogue specializing in posture and relaxation techniques. ISSTIP clinics were among the very first performing arts clinics in the UK, and they aimed to address the pressing issues of performing artists—general psychological and physical tension and pain and posture problems in practice and performance. The aim of this retrospective study is to examine the structure and success of the ISSTIP clinics and to look at what kind of models these early clinics represented compared with contemporary theory and practice.

PERFORMANCE AND LIFE FACTORS

Diversity of dancer experience in a dance program

Shona Erskine and Mary Ainley

This research describes the relationship between dance program structure and the types of experiences had by participating dancers. The research followed 48 participants through a 6-month dance project that culminated in a weeklong performance season. Recognizing that reported positive developments occur within the structure of programs, the aspects of a dance program that were significant in forming participants' different experiences were examined using a technique known as Q-methodology. The process of factor extraction and the content of factors are summarized to identify the different dancers' perspectives on their experience of the program. A discriminant function procedure was then used to determine whether demographic variables significantly discriminated between the groups. Divergent Q-sorts were analyzed to highlight that some dancers' experiences were different to the main types of experience available in the program. As dance participation has long been assumed to increase self-esteem, self-concept was measured using the Self-Description Questionnaire (SDQ). The paper concludes by outlining a multi-dimensional view of dancers' experience.

A circle of life: The Caroline Plummer Fellowship in Community Dance project

Barbara Snook

As the recipient of the Caroline Plummer Fellowship in Community Dance at the University of Otago in 2008, I coordinated a series of projects over a six-month tenure. The fellowship—which is in honor of Caroline Plummer, an extraordinary young dance student at Otago who died of cancer at the age of 24—offers the opportunity to research, examine, and explore the relationship between community and dance. My project was broken into five distinct sections. The first was a dance created by adult members of the cancer community; the second was art work created by visual artists responding to the adult dance sessions; the third was work facilitated with Canteen, an organization that supports young people living with cancer. I then wrote a children's book, *Come Dance with Me*, that deals with death and the healing power of dance. The fifth section involved working with senior high school dance students, who prepared solo choreographies around the theme of cancer.

Choosing the unstable: Dancing through the mid-career

Jo Pollitt and Dawn Bennett

While professional instability is a lifelong challenge for dance artists, it is in mid-career that instability becomes particularly problematic and the issue of sustainability comes to the fore. Mid-career artists build increasingly diverse protean careers in a bid to generate stability while dealing with unpredictable work patterns, aging bodies, and increased financial, family, and future responsibilities. In addition to this is the sense of physical and emotional loss experienced when the fundamental need to dance is not being fully met. In this study, we underscore these big picture issues with a more personal dialogue with three Australian mid-career dance artists. Through these case studies, we examine the constant negotiation, reassessment, and instability inherent in dance careers. Our research reveals that "putting the body down" often entails putting down work, status, and identity.

PHYSICALITY OF PERFORMANCE

Physical movement and imagery in professional and undergraduate student solo marimba practice

Mary Broughton and Catherine Stevens

Cognitive strategies and imagery are important features of expert musical practice. Movement imagery is important for developing note-accurate marimba performance. We report findings of a study where four professional marimba players and four undergraduate student marimba players completed questionnaires regarding their practice strategies and use of imagery in performance preparation. Since pedagogical marimba practice involves developing movement imagery, each participant also completed the Movement Imagery Questionnaire (MIQ-R) to measure subjective kinesthetic and visual imagery ability. As expected, professional musicians' qualitative reports of practice were driven by cognitive strategies. The student musicians reported more regular practice habits focusing primarily on physical practice. Professional musicians reported use of imagery in practice more often than student musicians. As predicted professional musicians' kinesthetic imagery was significantly greater than student musicians'. Contrary to prediction no significant difference was observed between professional and student musicians' visual imagery. Results offer some support for a pedagogical approach to marimba playing specifically aimed at developing note-accurate performance through kinesthetic awareness and imagery.

Monitoring work and rest during performance and life-style: A study case with a principal ballet dancer

Luís Xarez, Fernando Pereira, and Gonçalo Mendonça

Traditionally, dance training is based on day-to-day technical routines: the class. Studies in dance physiology started in the 1980s have shown that there are significant differences between the effort made during performance and that made in classes. The challenge for researchers and for those in the field (dancers, teachers, choreographers) is to find out training methodologies that allow improved performance, reducing the high number of injuries and prolonging careers. In this paper, we present a research methodology that can help to improve dance training by changing the starting point: past or future. Planning based on the past is to continue to repeat the same routines as always has been. Planning based on the future requires an analysis of the future task (dancing a particular role)—technical, energy, informational, psychological, and artistic—so that the preparation takes into account these different demands; what is known today as nonlinear periodization. This training must be specific and individualized.

Will supplemental fitness training have an affect on the aesthetic components of contemporary and classical ballet dance performance?

Matthew Wyon, Emily A. Twitchett, Manuela Angioi, George Metsios, and Yiannis Koutedakis

Exercise scientific research in dance to date has mainly been observational in nature; there is a paucity of literature investigating the effect of supplemental fitness training on dance performance. Many dancers have cited fatigue as one of the most prominent causes of injury and a decrease in performance components. The aim of the current study was to examine the effects of specifically tailored fitness training program on the incidence of injury and the quality of performance of both classical ballet and contemporary dancers, compared with relevant control groups. Participants underwent a series of fitness tests and a proficiency in performance test at the outset and end of the study. The intervention groups partook weekly training session that included aerobic interval training and circuit training. Data regarding injury incidence were collected with the assistance of the dancers' physiotherapist. Results indicated no significant difference in injury occurrence between the respective groups. Both classical ballet and contemporary intervention groups significantly increased their performance scores ($p < 0.05$) compared with their equivalent control group. It was concluded that supplementary fitness training has a positive effect on the aesthetic components of dance performance as studied herein; further research is recommended on a larger and more varied sample.

DEFINING PERFORMANCE

Is composition a mode of performing? Questioning musical meaning

Jorge Salgado Correia

The formalist approaches, focusing mainly on scores—which are just sets of instructions—have missed a significant part of music's processes of meaning production and its communicational dimension. This research is an attempt both to acknowledge the role that personal meanings play in the creation of a composition and of its performance and to verify if composers and performers work from the same mode of knowledge when making their respective meaning constructions. Based on gesture *intermodality*, a composer and performer created, separately, two video-clips that express the personal meanings that have guided their respective compositional or interpretative choices concerning two sections of a piece for solo flute. The two pairs of video clips were analyzed, compared, and conclusions were drawn. The results showed that, in spite of the different imagery used by composer and performer, the relations of tension and relaxation, movement, and rest were analogous: it appears that the personal meanings of the composer guided his work procedures to create those relations and that the performer has created a personal emotional narrative to give meaning back to those same relations. This study could support future research on the application of gesture intermodality in teaching strategies for musical performance.

Seeking excellence in danced postgraduate degrees

Maggi Phillips

Excellence as an evaluative category is implicit in the attainment of "doctorateness," so how can excellence be evaluated? The practices of dance, now recognized as legitimate components of doctoral studies, complicate evaluation processes while suggesting possible revisions as to how these processes may be refined. The combination of tacit knowledge and engagement, though contrary in logical senses, may provide a dynamic solution for evaluating studies that exceed a concept of excellence constrained measurement.

Intention revisited: From composition to performance

Helena Marinho and Sara Carvalho

Within the context of Western art music performance, intention is a fundamental key concept, generally viewed as a representation of the composer's creative and interpretative intents. Even though intention is considered a decisive factor in performance, the focus is placed on the composer, and the performer's own range of interpretative choices has been neglected. This issue is especially pertinent in collaborative work between composer and performer(s) in the interpretation of contemporary repertoire, often informed by the intentional contribution of both parties. This research focused on a case study, documenting the collaboration between a composer and a performer, which involved the première of a new composition for pianoforte, and intended to demonstrate that: (1) the concept of authorial intention, which is traditionally viewed by performers as a mandatory interpretative framework, can also be addressed from the performer's perspective and (2) a multi-level appraisal of intention can be applied to collaborative procedures in order to promote a successful performance. The concepts of authorship and intention provided a theoretical framework for the analysis of the collaboration process, establishing a parallel between the dichotomies author/reader and composer/performer, and the concept of intentional level was applied in the description of the collaboration stages.

PSYCHOLOGY OF PERFORMANCE

When repetition isn't the best practice strategy:

Examining differing levels of contextual interference during practice

Laura A. Stambaugh

Two experiments examined the effects of blocked and random practice schedules on the performance accuracy, speed, and temporal evenness of performance by wind players. Blocked schedules used repetitive practice orders, while random schedules constantly changed the order of tasks practiced. Beginning clarinet students completed three days of practice on three short technical tasks, in either a blocked or random order. Twenty-four hours after practice, beginning students who had practiced in the random order were able to play significantly faster than students who had practiced in the blocked order ($F_{1,38}=24.95$, $p<0.001$, $\eta^2=0.92$). Students in the blocked group performed significantly slower at 24-hour delayed retention than immediately after practice ($p<0.001$). Contrary to non-musical motor learning investigations, there was no speed-accuracy trade-off: students maintained high accuracy scores while speed gradually improved. In Experiment II, university wind students practiced three short technical tasks in either a blocked or random order for two days. Retention testing occurred 24-hours and one week following practice. Preliminary results were presented in the conference session.

Imaging the music: A context-specific method for assessing imagery ability

Terry Clark and Aaron Williamon

This study compared timing profiles of live and mental performances to determine if such an approach could provide a context-specific and objective indication of musicians' imagery abilities. Of further interest was how performance on this type of task may relate to scores obtained on standard imagery use and vividness measures. Thirty-two music students were recruited from the Royal College of Music (RCM). They first completed two imagery use and vividness measures, followed by two live and two mental performances of a two-minute extract of their choice. Following the generation of timing profiles for each performance, correlations were calculated within and between the two performance conditions. These were normalized by conversion to Z-scores and then compared with results obtained from the imagery use and vividness measures. While all participants achieved a significant correlation between the timing profiles from the live performance condition, only 17 did so within the mental performance condition. When comparing the timing profiles between the two conditions, 22 obtained significant correlations. Significant correlations emerged between the imagery vividness measures and Z-scores from the live performance condition, while amount of time spent employing imagery significantly correlated with Z-scores from the mental performance condition.

Learning to play double bass by stimulating mental imagery

Emmanuel Bigand, Thierry Pozzo, and Christophe Beraut

It is well established that mental simulation of movements has beneficial effects on learning and rehabilitation of a large range of gestures. Dot pattern videos were found to be of great efficiency to stimulate mirror neurons because they stimulate dorsal pathways more than standard video recordings. Until now, these effects were mostly reported

in the domain of sports or medicine. Only a few studies attempted to generalize them to music. The purpose of this study was to optimize the learning of double bass in beginner children (mean age=8 years) with a new method that encourages mental simulation of basic movements of the right (bow) and left hands of double bass players. The improvement in performances in children was also documented with a light motion capture device that tracked several parameters of the bow speed and right arm movement. Eight children who had recently begun studying double bass at the conservatory in Dijon used a traditional method consisting of 24 lessons (one per week) accompanied with a DVD. The DVD contained a set of 24 imagery training sessions, each being associated with one lesson. Each week, the children completed approximately ten mental imagery exercises displayed on the DVD. These exercises were designed to boost associations between movement-audition, movement-sight reading, and movement-musical expression. All videos were made with dot patterns methods. The improvements of the child were followed by registering the number of errors made for the mental imagery exercise and by capturing the evolution of their motor performance on the double bass with a light motion capture device, easily transportable to the conservatory. The device allows the measurement of velocity, acceleration-deceleration of movements, as well as the online changes of the angles formed by different parts of the arm.

PERCEIVING PERFORMANCE

Computer assisted analysis and display of musical and performance data

Stuart Pullinger, Nicholas J. Bailey, Jennifer MacRitchie, and Margaret McAllister

The coordinated storage of performance data in such a way that it can be used across multiple projects is problematic: general purpose systems that can store gestural, score, and other performance data are not generally available. Using data from current projects, we aim to provide a unified database that can store and present a musical score alongside associated performance data and musical analysis. Using a general purpose representation language, Performance Markup Language (PML), aspects of performance are recorded and analyzed. Data thus acquired from one project is made available to others. Presentation involves high-quality scores suitably annotated with the requested information. Such output is easily and directly accessible to musicians, performance scientists, and analysts. We define a set of data structures and operators that can operate on musical pitch and musical time, and use them to form the basis of a query language for a musical database. The database can store musical information (score, gestural data, etc.) and audio/video artifacts. Querying the database results in annotations of the musical score, potentially augmented with audio/video selected from stored performances. Two demonstrations are provided: an analytically-based query and a performance-gesture-based one. In the former, dissonant notes/intervals are identified in a performance of a Bach two-part invention. The score is then graphically annotated to indicate the performers' mean inter-onset intervals in the neighborhood of these features. In the latter, a score of a 19-ET microtonal song is displayed, annotated with the deviation in the soprano's pitch from that notated. The database is capable of storing musical score information and multimedia recordings and cross-referencing them. It is equipped with the necessary primitives to execute music-analytical queries, and highlight notes identified from the score.

Gestural communication: Linking multimodal analysis of performance to perception of musical structure

Jennifer MacRitchie, Bryony Buck, and Nicholas J. Bailey

A two-tiered experiment was conducted to assess the communication of phrasing structure from performance nuance to audience perception. Nine solo piano performances of two selected Chopin preludes, comparable in musical structure and complexity, were recorded multi-modally through audio, MIDI, and the Vicon motion capture system. Analyses of performance parameters such as tempo, dynamics, and movement were then conducted with reference to the notated score. Videos of each performance were presented to observers with musical knowledge who used a slider to determine the shape of each musical phrase. Having previously been presented performances in visual only mode, participants were now presented the performances in three modalities: visual, audio, and audiovisual. Further to findings that occurrence of performance gestures correlated with notated and perceived phrase boundaries, multimodal analysis of performance parameters confirmed that performers conveyed musical structure as intended in auditory as well as visual elements of performance.

Music performance venues: Keeping them in tune with modern requirements

George Dodd

Throughout the history of music composition and performance we can perceive a strong link between compositional style, the qualities of places where composers imagined their music would be played, and the instrument technology

of the age. We must examine whether modern listening preferences are now being shaped by the capabilities of modern recording technology to the point where it is no longer possible to satisfy these in a live performance venue using a passive design (i.e. non-electroacoustical). The results of a survey of music listening habits and preferences imply that live-performance venues should respect an “originality” criterion and not impose features on a performance which are inconsistent with the architecture and technology of the era (or intention) of the composer.

Keynote paper

The dominant artistic discourse as a health determinant

Sylvie Fortin

This paper examines how elements of different discourses are appropriated or resisted by artists and the effects on health and wellbeing. More specifically, the results of a series of ethnographic studies—conducted with professional dancers, choreographers, rehearsal directors, and students in different contemporary dance settings in Montreal—are presented. Although aesthetic and ethical issues based on grounded empirical material in dance are discussed, many ideas can be transferred to other performing art forms. Vocation or passion for the arts is often presented as an explanation for why artists jeopardize their health and accept difficult working conditions. However, these studies demonstrate that the dominant discourse in the performing arts, which values the supremacy of artistic work and the surpassing of one’s limits, is at the top of a long chain of decisions that negatively impact artists’ health. Unless all participants in the dance milieu, individually and collectively, critically address the different discourses and their embodied “truth,” positive changes in dancer’s health and wellbeing will remain limited.

National Institute of Creative Arts and Industries, The University of Auckland

The National Institute of Creative Arts and Industries (NICAI) is a centre of excellence and innovation in contemporary creative arts and industries research, education, and practice.

NICAI brings together under one umbrella the University's School of Architecture and Planning, Elam School of Fine Arts, School of Music, the Dance Studies Programme, and the Centre for New Zealand Art Research and Discovery. It works from the principle that creativity emerges from drawing together different perspectives and types of specialist knowledge within an interdisciplinary framework.

The Institute is also a major contributor to Auckland's thriving arts community, offering a diverse program of concerts, exhibitions, lectures, and other arts and cultural events each year.

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.

The Centre for Performance Science (CPS) was established in 2000 with the aim of fostering collaborative research and teaching among musicians and scientists at the RCM. From the investigation of music cognition and perception to the study of expert performance, the CPS benefits from its position within a vibrant musical environment. As such, the Centre is particularly well placed to explore the interface between skilled artistry and scientific discovery.

