

Can researchers help artists? Music performance research for music students

Richard Parncutt

ABSTRACT Scientific research on music performance is not only interesting for its own sake; it also has important implications for post-secondary music education. I present a vision for the future of academic training at post-secondary music institutions that incorporates a fruitful interaction between performance teaching and performance research. Research on the acoustics, physiology and psychology of performance on specific instruments may help students to make full use of the acoustical and expressive possibilities of their instrument and to understand its limitations. More general research on efficient practice and motivation may help students to optimise their practice routine. Research on musical expression (structural, emotional, bodily) may raise students' awareness of their expressive strategies and help them to plan and practise the expression that they bring to specific works, linking analysis to interpretation. Research on memory, sight-reading, improvisation and intonation may help students to enhance their skills in these specific areas. Research on performance anxiety may help students to turn anxiety to their benefit. Research on music medicine may help students to prevent and treat injuries. Content of this kind is not always included in post-secondary music curricula, because much of the research is quite recent and because music performance tends to be associated with intuitive rather than logical thinking. I argue for an increase in proportion, and a shift in kind, of such academic content. Music students may benefit, both musically and generally, from a more multi- and interdisciplinary program.

KEY WORDS: Music performance research, music college students

Introduction

Recent years have seen a steady stream of new books that present the results of music performance research and show how it can be applied to the everyday teaching and practice of music performance. Parncutt and McPherson (2002) covered general aspects of music psychology, the psychology of specific musical skills, and the acoustics of different musical instruments, and attempted to develop specific strategies for applying that research in music education at all levels. Rink (2002) combined relevant humanities scholarship (including music history and analysis) and scientific research (e.g., the psychology of memory) with the academically grounded views and experience of eminent performers and

teachers. Williamon (2004) presented a broad coverage of current performance research that is relevant for the best performers and music students, as well as physical and psychological techniques that can help music students achieve excellence. Odam and Bannan (2005) addressed such diverse topics as creativity, musical communication, improvisation, physiology of performance, and questions of artistic and ethnic interculturality. As the title "The child as musician" suggests, McPherson (2006) considered early musical development, but also presented a wealth of information that is relevant for post-secondary music institutions.¹ Altenmüller, Wiesendanger and Kesselring (2006) focused on the physiological basis of the virtuoso technique and demonstrated that modern brain research is becoming increasingly relevant for musicians. Lehmann, Sloboda and Woody (2007) aimed to help musicians without scientific or research training to interpret and apply the results of psychological research in music performance.

Fuelling these new books is a steady expansion of interest in music performance research, including not only conferences and postgraduate courses, but also a general acknowledgment from scholars and practitioners alike that collaborative, interdisciplinary investigations can contribute both to a greater understanding of performance and to the application of that understanding to practical music making. The theoretical knowledge gained in this research does not *necessarily* have practical applications for teachers and performers (nor should it), but clearly a lot of it can be applied in useful ways, many of which are only beginning to be put into practice.

In parallel with this grassroots expansion, government agencies, research councils, grant awarding bodies, and international post-secondary music institutions are encouraging performance teachers to engage in and document their "practice-related" or "practice-based" research. This is driven in part by a desire to quantify how performance teachers spend their time working within higher education, which can have both positive and negative consequences for the performers themselves. On the positive side, greater transparency may highlight the quality, difficulty and value of their everyday work, which may help them to organise their time more effectively or to attract funding. On the negative side, every investigation of performance teachers' daily work may be perceived by them as a restriction of their creative freedom.

The above books represent a sizeable and relatively accessible reservoir of information that can be useful for teaching and curriculum development. The question I wish to address in this paper is how, exactly, such materials might best be used. For mostly they do not directly answer fundamental questions such as the following:

- How can music educators - both full- and part-time - best inform themselves about relevant music performance research given their busy schedules and limited time?
- To what extent should they apply, or be able to apply, such research in their teaching?
- How much time should music students spend studying and applying that research?

¹ I use the term *post-secondary music institution* as a blanket term for all institutions whose primary aim is to train music performance skills. The term is intended to include all colleges, academies, conservatories, *Hochschulen* and universities of music ("music universities"). It is beyond the present scope to distinguish among different kinds of post-secondary music institution. The term "post-secondary" is equivalent to "higher" or "tertiary". In this context, the term "music" usually refers (ethnocentrically) to the notated music of Western cultural elites.

- To what extent should the curricula² offered by post-secondary music institutions include units based on music performance research that are presented by performer-researchers?
- Which units of study ought to be compulsory, which elective, and which entirely voluntary?

Post-secondary music institutions are increasingly coming under pressure to improve or enlarge the academic content of their activities (teaching and research) so as to emulate the status of universities. At the same time, demands on individual music educators are changing: as the volume of empirical research in music education and music performance grows, they are increasingly expected to be acquainted with aspects of that research that apply directly to their speciality, and to be able to apply it.

It is natural for well-established post-secondary music institutions with a long tradition of excellence to resist change, especially when that change involves research with which the administration may not be familiar and whose implications and benefits may be unclear in advance. Moreover, communication between performance teachers and performance researchers is often not well developed.

This raises fundamental questions about the possible benefits and dangers of teaching performance research to students. Can the *efficiency* of post-secondary music education be enhanced by presenting and applying research on music performance? By “efficiency” I mean the ratio of output to input, where input may be regarded as the time and effort that students devote to their training as well as the financial cost of their training, and output includes the musical quality of students’ performances after their training, the quality of the general education that music educators pass onto their students, and the general contribution that music students later make, either directly or indirectly, to the quality of life at different levels through their musical activities. Although the concept of efficiency has a disagreeable neo-liberal feel about it, no-one will deny that it is important to manage public money responsibly and to get the most out of limited resources; and students will be grateful for useful tips on how to get the most out of their practice time.

My paper is primarily practically oriented and draws on my experience both as a music student and a music performance researcher. Some details about my experience may be appropriate here, since performers and students reading this article may evaluate the authority of the text on the basis of my musical credentials. I studied music at the Faculty of Music, University of Melbourne from 1976 to 1980. The program had three nominally equal strands that covered the history, theory and performance of Western music. My piano teacher, Diana Weekes, has always been interested in performance research; she is now affiliated with the Elder Conservatorium of Music, Adelaide, and commented in some detail on a draft of this paper. I concurrently studied physics, which allowed me to compare three different ways of academic thinking (epistemologies): humanities, sciences and musical practice. My undergraduate studies also gave me the opportunity to experience a mixture of intensive performance practice and a full-time load of academic subjects - considerably more than I expect from the music students to whom this paper is addressed. For several years after finishing my undergraduate studies, I appeared regularly as soloist or accompanist in amateur performances. As a music performance researcher, I have carried out research on the psychology of piano fingering that combined empirical observa-

² I avoid the ambiguous term “course” and instead refer to “units” and “curricula”. A curriculum (or “program”) typically lasts 3-4 years; a unit within a curriculum typically lasts one semester.

tion and data analysis with computer modelling (e.g., Parncutt et al., 1997). I have also co-edited a book that covers the main areas of performance research (Parncutt & McPherson, 2002).

In the following, I will focus on aspects of music performance research that could realistically enrich the training of musicians and music educators. This research addresses issues as diverse as improvisation, expression, practice, performance anxiety, music medicine, and the physics, physiology and psychology of performance on specific instruments. After considering each of these topics in turn, I will proceed to some practical and political issues. Why are many such matters currently not taught, or not adequately taught? What might be the effect of introducing such materials to music and music education curricula? What political strategies might promote their introduction?

My contribution has an exploratory character. The envisaged pedagogical applications of music performance research are still in an early stage of development. I offer a range of issues for discussion but avoid giving premature answers to specific questions.

Academic units in post-secondary music curricula

Music students are generally exposed to academic materials such as music history and music theory/analysis, as well as conducting. Staff meetings about music curricula may feature lively discussions about the advantages and disadvantages of academic work for practising musicians. Some may argue that academic work should be reduced to an absolute minimum, claiming that music students need to spend as much time as possible on practice.

This argument is supported by psychological research on *expertise*. According to Ericsson et al. (1993), it takes about 10 years and, during that time, about 10 000 hours of practice to become a recognized expert in just about any competitive discipline, of which music performance is a good example. Most research on the acquisition of expertise - in areas as diverse as sport, chess or music - is consistent with the idea that you have to clock up at least that amount of hard work if you want to make it in your chosen field.

Of course there are individual differences. In the case of music, it takes longer for some instruments (pianists?) than others (flautists?) to acquire basic technical skills. Some instruments (violin?) may be fundamentally harder to play well (relative to the skills of the best current performers) than others ('cello?). And instrumentalists may begin learning their instrument at a very early age (four?) while singers may wait until their voices mature. Individual students entering any tertiary institution vary widely in the level of their relevant cognitive, physiological skills or "gifts" as well as other less quantifiable parameters such as motivation, creativity, and imagination; those with more of the latter may eventually overtake those who initially have more of the former. Ericsson did not ignore such variations, but went beyond them. His point, which is supported by a wide range of empirical data, was that the amount of practice time is centrally important in spite of obvious individual differences.

A music student who averages three hours of practice per day every day of the year (which may mean practising six hours on some days to balance the holidays, days off, days of illness, days during which practice was impossible due to travel, etc.) can accumulate about 1000 hours in a year. If the 10000-hour-hypothesis of Ericsson and colleagues is correct - and it has stood its ground since 1993 - and if a student enters a post-secondary mu-

sic institution with some 5000 hours of accumulated practice behind him or her, keeps up an average of three hours per day every day throughout four years of study and continues to practise and perform at about this rate after finishing study, Ericsson's hypothesis predicts that s/he has a good chance of becoming a recognised professional musician.

An obvious implication is that the academic units that I am proposing in this paper should take up a relatively small proportion of music students' time - perhaps between 10 % and 30% - so that students have plenty of time for practice. But students should not practice too much, either. Too much practice can be counterproductive, for two reasons: **Workaholism.** Moderate amounts of workaholism can be viewed as positive and even necessary. Both the research on expertise cited above and everyday experience suggest that one needs to be at least a little obsessed with one's work in order to succeed in competition with other, similarly slightly obsessed people in the same field. But obsession can also lead to psychological and social problems. Workaholics tend to be perfectionist, unable to delegate responsibility, stressed and unhealthy (Spence & Robbins, 1992). Like other addictions, excessive work is associated with "identity issues, rigid thinking, withdrawal, progressive involvement, and denial" as well as problems involving "decision making ... goals ... effectiveness ... interpersonal relations" (Porter, 1996, abstract). High achievers know not only how to work long and intensively, but also how to plan and fill their recreational time appropriately.

The risk of injury. The amount of practice that a musician can do in one day can be limited by the risk of performance injuries and other medical problems, for which the most common causes are stress and overuse (Brandfonbrener & Kjelland, 2002). There are presumably large individual differences in the ability to cope with stress. The risk of injury can be reduced by appropriate playing techniques and by practising more efficiently so as to reduce the total duration of daily practice. The latter may be achieved without slowing progress by regular silent (mental) practice, which may be regarded as part of practice in the broader sense of any preparation for performance. But the degree to which mental practice can substitute for real physical interaction with instrument and sound is limited.

It follows that academic work may *at the very least* be a relevant distraction that reduces the chance that music students become obsessed with practice or develop medical problems - assuming, of course, that the students already have the time and facilities that are necessary to practise effectively. But academic work can also broaden students' horizons in ways that make them more interesting, self-efficacious (self-reflective, creative, independent...) people and also, directly or indirectly, improve their musicianship. In this sense, academic training may be considered as a central and integral part of the training of all-round, intelligent musicians.

How much time, exactly, should music students spend on academic work by comparison to performance and practice? This question is not easy to answer:

- The ratio depends on the optimal amount and distribution of practice time for a given student on a given instrument.
- The ratio depends on the kind of academic materials that are likely to be musically useful to individual students. What will help them to acquire the technical abilities that they need to reach their specific musical goals? To develop effective, original interpretations? To make appropriate career choices? What are their academic interests - regardless of any implications for their performance?
- The ratio depends on each individual student's personality and approach to learning (cognitive style). Curricula need to be flexible enough to allow for considerable varia-

tions in these factors and - if possible within the usual financial restrictions - provide for monitoring and discussion in which students can verbalise and develop their own specific needs and aspirations.

- The ratio depends on the institution - its history, its general orientation, and its internal culture. Changes to the curricular offerings of an institution should be big enough to maintain the institution's dynamism and small enough that valuable traditions are maintained.

To understand these issues properly, it may be interesting to research the history of the specific institution (e.g., Wright, 2005) and to compare the history of similar institutions in different countries, for example the Royal College of Music in London, the Paris Conservatoire, the Juillard School in New York, the Indiana University Jacobs School of Music in Bloomington, the Sydney Conservatorium, and equivalent institutions in Asia, Africa and South America. It may also be useful to compare the basic statistics of such institutions: student and staff numbers, budgets, internal structure, links to other institutions or universities, courses offered, balance of academic and practical work, assessment practices and extracurricular support services. This may be done on the basis of existing data without subjecting performance teachers to (additional) evaluation procedures.

Specific academic units

Music students may be offered, required to take, or required to choose among academic units of differing degrees of specificity. They are traditionally offered courses in music history, music theory and aural skills. To these may be added a mixture of introductory and advanced or specific courses.

Introductory courses (aka foundation materials) may include general introductions to areas such as music psychology and music performance research. They should be placed relatively early in the program (in the first or second year) and be prerequisites for later, more specific units. It may be appropriate to make them compulsory for all students, as without them they are not in a good position to evaluate the advantages of later units. At the very least, they may represent an interesting alternative for those who are already proficient in aural skills.

More advanced units should generally be elective or voluntary, and may be classified into broad areas such as theory/analysis/composition, performance, teaching, and personal development. The present paper focuses on performance and personal development, but the other two categories are no less important. Students of theory, analysis and composition should be given the opportunity to learn about and apply relevant recent research in music psychology (e.g., Bigand et al., 2003; Ferguson & Parncutt, 2004; Krumhansl, 1990; Larson, 2004; Parncutt, 1989, 2004; Temperley, 2001; Tillmann, et al., 2003). Regarding teaching, all music students should be encouraged or required to take advanced units, because so many will teach in their later careers; such units may focus for example on the application of appropriate pedagogical theories to specific teaching contexts and situations, or the educational implications of research in developmental music psychology (e.g., McPherson, 2006).

Advanced academic units on performance may apply either to most (all?) instruments or to specific instruments.³ Units that apply to all instruments may address questions such as

³ Here, I consider the singing voice as an instrument and different voices (from bass to soprano) as

how to practise efficiently or improve one's ability to memorise, improvise, sight-read, or communicate structure and emotion (expression). They may also address aspects of personal development including performance anxiety and medical problems. Any topic that supposedly applies to all instruments will be approached differently by performers of different instruments, but presenting such materials in a general fashion will also allow students to benefit from exposure to issues faced by other instrumentalists. Units that apply to specific instruments or instrument families may address the physics, physiology and psychology of performance on that instrument in detail.

Post-secondary performance institutions have never completely neglected these aspects of a rounded music education, but from the point of view of modern performance research, their approach has been problematic. Performance teachers have been expected to address such issues on the basis of their personal experience and intuition. The recent growth of research in these areas means that this material can increasingly be taught in separate units by experts who perform the research themselves. In the following, I give a quick overview of such units - just enough to whet the reader's appetite. More details can be found in the books listed above.

Physics, physiology and psychology of performance on specific instruments

Instrument families differ considerably in their underlying physics as well as the physiology and psychology of performance. To cover more than one instrument family would exceed the scope of this article. Therefore, I will focus on piano, which also happens to be the instrument that I know the best.

Once musicians acquire a substantial technique, they tend, both as performers and teachers, to focus on expressive communication and interpretation. The consequences for student pianists were documented by Parncutt and Holming (2000). We observed that student pianists know remarkably little about the physics, physiology and psychology of piano performance - not because of any lack of interest, but because of a lack of exposure to the material or to pianists who understand it well and regard it as important. Piano students know relatively little about the mechanics and acoustics of the piano, the relevant physiology of the fingers, hands and arms, and relevant aspects of the psychology of motor control and rhythmic coordination. They are unclear about what can and cannot affect the timbre of a single piano tone or a whole passage of music. They do not know that the timbre of an isolated tone depends *only* on key velocity, noises (hammer-string, key-keybed, finger-key) and pedals. Nor can they explain how the piano nevertheless produces remarkable timbral richness and variation. They are unable to describe their own strategies for determining fingerings and the contrasting roles of physical, anatomic, motor, and cognitive constraints, and they are often unclear about how fingering may depend on expertise and interpretation. They often do not realise that if they play one note in a chord in one hand louder than the other tones, and all keys in the chord are struck (or begin to move) at the same time, the faster key will reach the keybed before the others, so the louder tone will physically begin earlier; nor can they explain why this effect is often inaudible, how it can be controlled, or whether it should be controlled or deliberately encouraged (cf. Goebel, 2001).

We may have been expecting too much. After all, the same students may not have been

members of an instrumental family.

able to demonstrate much knowledge about music history or theory, either. But they may nevertheless have been excellent pianists. One does not need to understand how a car works in order to be able to drive it excellently. Independently of any discussion about academic study, music students must be constantly aware of the sound that they are producing: the goal is more important than the road that leads to it. Moreover, the process of acquiring analytical knowledge about the mechanics of performance may affect student musicians' instinct for aural exploration or their sensitivity for those mystical qualities of music that cannot be reduced to physics or rationality.⁴

One may nevertheless confidently assert that piano students at a "music university" should have at least some familiarity with the above topics and questions. Because pianists spend long hours every day practising, it is important that this time be spent efficiently. Improved knowledge of relevant physics, physiology, and psychology - which can be acquired in a fraction of the time necessary to acquire advanced pianistic skills - may help pianists to achieve technical and interpretative goals more quickly. These arguments may be valid even if the technical and musical benefits are unclear or are not enjoyed by all pianists.

Practice

Since musicians and music students spend very large amounts of time practising, it is important for them to systematically consider and compare different approaches to practising. The ultimate aim of such an exercise might be to make their practice more efficient, so that they can reach specific technical goals with a minimum of time and effort, leaving more time for interpretational exploration.

Relevant psychological and pedagogical research in this area was summarized by Barry and Hallam (2002). A diversity of approaches is generally better than a limited number; possible approaches include the study and analysis of scores, mental versus physical practice, and listening to recordings of works being studied, as well as live performances. Practice is more efficient when musicians can think and talk about the advantages and disadvantages of their practice routine or habits, and plan the structure of their practice sessions according to the specific goals of that session. In the psychological literature, this is referred to as *metacognition*, or thinking about thinking.

An important prerequisite for any long-term practice program is *intrinsic motivation*. Practice is most effective if the musician is motivated not only from without (extrinsic motivation, such as the pressure of a coming concert) but also from within (intrinsic motivation, such as the pleasure or reward of practising for its own sake). Intrinsic motivation is related to the experience of *flow* (Csikszentmihalyi & Rich, 1997; B. J. Kenny & Gellrich, 2002), and can be enhanced by subdividing a practice goal (such as learning a piece for performance on a certain date) into individual subgoals. To encourage flow states, these subgoals should be pitched relative to the musician's level of skill: they should be difficult enough to represent interesting challenges, but not so difficult that they might lead to frustration.

Music students could benefit from a study unit or similar that not only presents this

⁴ It would be interesting to study this effect empirically - does it exist at all, and if so what is its duration?

kind of research but also gives them a forum to talk about and investigate their own practice routine and to find out how other students and teachers practise. Such a unit might aim to balance theory based on published psychological studies against systematic, constructive interaction with peers who have similar or different problems. The instructor should also spend some time supervising the practice of individual students. Students would need a method of evaluating the success of the new approaches to practise to which they are exposed.

Improvisation

The ability to improvise may be unnecessary - but still useful - for students with a classical focus. Training in improvisation can improve their practical knowledge and practical command of relevant musical styles and help them to recover from memory lapses in performance. This point together with the growing literature on improvisation in various disciplines suggests that the time has come for performance teachers in all musical styles, including "classical", to address this issue. Many undergraduate curricula already include a selection of theoretical and practical approaches to improvisation in various Western (jazz, organ, early music) and non-Western musical styles and genres, and in music education. The teachers of such courses may benefit from collaboration with performance researchers, who can provide theories, strategies, and evaluations of pedagogical approaches.

The topic of improvisation is interesting for all musicians and music educators from early childhood education to the training of the most advanced performers. Why has it been neglected? Within the European musical tradition, the art of improvisation all but died out during the 19th Century, as printed music became freely available. Previously, it had been common for both teachers and students to improvise exercises and thereby to simultaneously train technical, improvisational, auditory, harmonic and expressive skills (Gellrich, 1992). During the 20th Century, many mainstream Western music teachers felt unable to improvise or to teach improvisation, because they themselves had no training or experience. Today, it is still difficult to convince teachers, parents or administrators of the virtues of developing improvisational skills, because many of the best musicians still lack those skills - a vicious circle.

It is not hard to play an ostinato accompaniment while a student improvises a simple melody over the top (or vice-versa), or to create call-answer improvisations together with a student. The hardest challenge may be to overcome deeply entrenched inhibitions. But once the ice is broken, both teacher and student can make steady progress. Can music performance research develop new and effective approaches?

Lassnig (2004) developed psychologically inspired strategies for teaching improvisation. He first recommended having students improvise within strictly defined limits. For example, a student might improvise rhythmically and expressively on a single tone, then on two tones, then three. Or analogous dynamic, rhythmic or articulatory limits may be established in advance of an improvisation. It is revealing and motivating for students - even advanced jazz players - to (re-) discover the extent to which one can make "music" within such strict limits. Such an approach can also clarify why many musicians find improvisation difficult: improvisers must invent two things at once, notes and expression. Having recognized that, a pedagogically effective strategy may be to focus on the expressive aspect

and to encourage flow states in which musical and technical challenges are matched to existing skills. This may indirectly accelerate the learning of patterns such as scales and chords. In this context, Lassnig developed the idea that instead of practising improvisation on specific structural elements such as a chord or mode, specific structural elements can be combined with specific skills, so that only one element and one skill are practised at a time. Examples of “skills” are listening, seeing, moving (technique), feeling and knowing. Separating these from each produces a large number of combinations to practise individually.

Expression

Music students seldom receive *explicit* instruction on *specific* means of musical expression (possible exception: affect in early music). Instead, they imitate the expressive styles of their teachers and other performers that they experience in concerts and on records. In that way they gradually develop their own expressive style. This process happens largely intuitively, without students or teachers analysing the detailed, note-for-note relationship between expressive parameters such as timing and dynamics and the structure or emotion that is being expressed.

Popular ideas about musical performance and performers are largely based on accounts of musical talent and genius, for example in biographies of eminent musicians in programme notes and magazines. Such sources emphasize that musicians’ strong, personal experiences of the emotions that they express is the basis of their ability to move an audience. But while authentic emotional involvement is clearly important, performers are also aware of the pitfalls of getting too involved. In order to remain technically in control, it is often necessary to maintain an appropriate distance from the emotions that one is communicating. Seen from this viewpoint, the art of musical performance is one of manipulating the audience’s motions.

How is this done? Psychological research on expression has clarified the issue in a number of ways. First, a distinction has been made between *structural* and *emotional* communication. Expressive performance parameters that make it clear, for example, when a phrase ends and a new phrase begins, are structural. The way in which this is done (the shape of tempo/dynamic functions or gestures) can determine the specific emotions that are communicated. Thus, it is possible to separate the *goals* of structural and emotional expression but not the *means*, which overlap.

Friberg and Battel (2002) analysed some of the means with which performers communicate musical structure to their audiences. Their approach is well suited to computer simulations of musical expression, in which a computer converts a score into a sound file that sounds considerably more “musical” (“natural” and expressive) than a direct conversion of score into sound. Their approach may also be applied in music education, if the complex relationship between specific structures and associated expressive devices can be concisely explained and illustrated by a human performer at a real instrument. In Parncutt (2003), I presented a simplified and generalised version of their theory based on an extended concept of accent - any musical event to which attention may be drawn, or any *salient* (perceptually important) event. An event can be salient for reasons that are clear from the score (*immanent accent*) or for reasons associated with the manner of performance (*performed accent*). Examples of immanent accents are melodic accents (the peak of

a melodic contour) or grouping accents (the start of a phrase). Examples of performed accents are temporary decreases of tempo (the delaying and lengthening of individual tones) and temporary increases (or sometimes decreases) in dynamic level. Performers often use performed accents to attract attention to important events (immanent accents), which can make the structure of a piece of music clear to listeners. In other words, performed accents often have the function of reinforcing immanent accents. This apparently trivial observation can form the basis for a systematic approach to understanding expression and to raising awareness of one's own intuitive expressive strategies. The fact that performed accents can be introduced into a performance in many different ways and combinations is consistent with the wide variety of possible effective interpretations of a piece of music.

The way in which performed accents are deployed is a matter of interpretation and involves a number of intuitive, artistic choices. These include the temporal positions at which the accents fall (i.e., which immanent accents should be reinforced and which not), the strength of the accents (how clearly they are perceived), and the physical way in which they are realized. In piano performance, for example, performed accents may be realized by changing loudness, tempo, or both; and the shape of the function of loudness and/or tempo against time is variable. Since the performer is not necessarily aware of the way in which s/he is using performed accents, and one of the aims of applying this theory of expression in music education is to make this process more conscious and deliberate - at least during practice and training.

Psychological theories of structural communication can form the basis for a new approach to *music analysis* that is directly relevant to music performance. A unit on this subject might begin with the analysis of passages of music that students are currently practising, marking different kinds of immanent accents with different symbols. Next, students might analyse their own playing of the passages - perhaps by listening to recordings of themselves. What are they intuitively doing in the vicinity of specific immanent accents? What kinds of accents are they choosing for expressive treatment? What kind of treatment? Which accents are being ignored? How does this pattern change when they play different kinds of music? In this way, students can develop performance-oriented analyses of their repertoire while at the same time becoming more aware of their own expressive strategies.

A similarly analytic approach has been developed by Juslin and Persson (2002) in the domain of emotional communication. On the basis of a large body of empirical data, Juslin summarized the expressive techniques associated with specific emotions such as anger or tenderness. For example, anger is characterized by "high sound level, sharp timbre, spectral noise, fast tempo, staccato articulation, abrupt tone attacks, increased durational contrasts between long and short notes, no ritardando, sudden accents, accents on tonally unstable notes, crescendo, phrase accelerando, large vibrato extent" (p. 223). This seemingly trivial observation becomes interesting when students try to apply it to specific musical contexts. Which of the points in Juslin's list can appropriately be applied to a passage in a given style? How successfully can students communicate a given emotion using this method? To what extent are they capable of discriminating between different emotions in their performance? This is surely an important skill that deserves to be studied and practised separately from other skills. As such it could usefully be included in every musician's technical toolkit. Like other skills, it can first be acquired analytically and later combined with other skills - integrated into the student's holistic personal interpretive style.

Empirical data (e.g., Woody, 1999) confirm that an analytical approach of this kind can help musicians to communicate emotion. But it is unclear to what extent such training can transfer from the confines of a controlled experimental situation to the concert platform and to a range of different musical styles. Besides, an overtly analytical approach may be more suitable for some personalities and cognitive styles than others. Beyond that, it is the everyday experience of performance teachers that some students have “something to say” musically and others do not. The extent to which the desire and ability to communicate musically can be trained, and if so how, is unclear.

Personal development

The personal and musical development of individual students may be supported through guided or coached self-reflection, including such personal factors as motivation, behavioural patterns, stress management, goal orientation, self efficacy, self regulation, and attributions (Dweck, 1999; Painsi, 2007). Here, I will not consider the personal development of musicians in detail, but instead address two central aspects: *anxiety* and *injuries*. These two issues are closely related to each other (Williamson & Thompson, 2006). Both are important for most musicians, because most musicians suffer or have suffered from both. And in spite of recent developments in research and improved dissemination of research findings, the general level of awareness among musicians about symptoms, causes, preventive measures and treatments in both areas remains low. In music curricula, it may therefore be appropriate to address these two topics within the same unit that also considers broader issues of the three-way interaction among the individual musician, the music being performed, and the society that “consumes” the “product”. Such a unit should balance classroom work with individual coaching.

Performance anxiety

Research on performance anxiety has been summarized by various authors including T. D. Kenny and Ackermann (in press), Mornell (2002), and Wilson & Roland (2002). In the following I aim to whet the reader’s appetite with selected ideas from this burgeoning field of research.

It is common knowledge among musicians that a small or moderate amount of performance anxiety can benefit a performance. The performer becomes more alert and more responsive to the audience, the situation, and unexpected musical events as they occur spontaneously during a performance. Performance anxiety only becomes a problem when it is so strong that the performance is negatively affected by errors and slips of memory, loss of control over interpretation, and so on.

The extent and nature of performance anxiety depends on three main factors: the personality of the musician, their mastery of the task in hand, and (their perception of) the situation in which they perform (Wilson, 2002). The knowledge that these three aspects can be separately analysed may help musicians to develop realistic strategies to counter performance anxiety in specific situations:

- A musician may be generally shy, anxious or afraid of people, regardless of whether music is involved or not (*trait anxiety*). Such students may benefit from psychotherapy

that is tailored to deal with this problem. Of course, this is a sensitive issue that should be approached very carefully by teachers.

- Performance anxiety depends on the extent to which a student is technically and musically prepared for a performance. If this turns out to be the main problem, the student has no choice but to practise more, or more effectively.
- Performance anxiety depends on a performer's self-expectations in relation to a given audience, which in turn depends on the performer's cognitive construction of the audience's perception of the performance. If this is a major issue, the performer may benefit from specific procedures such as *systematic desensitisation*, in which the "threat" is gradually increased, or *cognitive restructuring*, in which performers develop more realistic and positive expectations about the audience's expectations and adjusts their self-expectations accordingly.

Performance anxiety may be treated or managed in a variety of ways including meditation, physical relaxation, breathing exercises, yoga, aerobic exercise, hypnotherapy, Feldenkrais, the Alexander technique, psychotherapy, guided imagery, religious faith, coping skills development and assertiveness training. The empirical literature is only beginning to systematically investigate the effectiveness of such therapies and interventions.

Music medicine

In a broad definition, the term "music medicine" involves all medical problems that may be caused or exacerbated by musical performance, ranging from counterproductive everyday levels of stress and tension to chronic pain and disabilities.

Music students and musicians often suffer from chronic tension or reduced muscle elasticity in the pelvis, lower spine or the back of the neck (Erlitz-Lanegger, 1997). Problems like this can arise when similar motor actions are repeated countless times while the rest of the body is held in a relatively inflexible posture. Since motor actions and postures differ from one instrument to the next, each instrument or family has its own characteristic medical problems. Medical problems also depend on the kind of repertoire being performed, the personality of the musician, and the interaction between the two. For this reason, it is important that medical practitioners specializing in music medicine have a complete picture of the musical situation in which the problems develop (Brandfonbrener & Kjelland, 2002).

A lot of useful material could be packed into a unit on music medicine. The unit could begin with a presentation of relevant background information in anatomy and physiology, and proceed to develop exercises that students can perform at and away from their instrument. Students may be given advice on organising their practice time, dealing with the stress of approaching performances, and sport and nutrition. Teachers who work with children may need specific guidance. All these points can also be topics for group discussions.

Those who are not convinced of the relevance of such materials for music or music education curricula should consider the implications of *not* providing this information. Prevention is better than cure: serious problems can presumably be prevented if one is aware of the problem in advance and has a repertoire of strategies to avoid it. But if a musician waits for a problem to become chronic, it can affect her or his whole career and necessitate repeated medical consultation over a long period. Regardless of whether the costs

are carried by the individual or the state, medical treatment is expensive. Of course, an increased awareness of the causes and symptoms of music medical problems may not necessarily prevent them. But even if increasing music students' awareness can only sometimes prevent the emergence of medical problems, it is worthwhile investing in awareness-raising.

Analytic versus holistic thinking

How should the above materials be presented to music students? An optimal pedagogical approach depends not only on the students' interests, motivation and relevant background knowledge, but also on fundamental issues such as how they think (Painsi, 2004).

In their everyday work, musicians rely on a wide range of technical and cognitive skills. They need to be able to think both analytically and holistically. Analytical or logical thinking is necessary to understand the mechanics of musical instruments, the conventions of music notation, one's own performance technique (motor control), and the physical and perceptual complexities of musical sound production. Holistic or intuitive thinking is associated with skills of musical interpretation and empathy with other people, including conductors and ensemble musicians, audience members, and composers, both living and dead. Evidence for the constant interaction between analytic and holistic thinking in music performance is the increased size of the corpus callosum in musicians (Schlaug et al., 1995); the corpus callosum links the two brain hemispheres.

Everyday experience suggests that, on the whole, musicians and non-musicians think in different ways - they have different *cognitive styles*. Since musicians spend such a lot of time expressing themselves in sound, one might expect them to excel in ways of thinking consistent with that activity. Since they spend less time doing other things, one might expect that they are less skilled in mental abilities that are inconsistent with musical practice and performance. Musicians also differ considerably from each other in this regard (Kemp, 1996).

Brandler and Rammsayer (2003) investigated the cognitive styles and abilities of musicians and non-musicians by asking them to perform standard psychological tests. The musicians scored better on verbal memory tasks, while the non-musicians were better at logical problems such as completing a series of pictures, spotting which two pictures out of a set of five violate an implied rule, completing a matrix, and topological reasoning. It was unclear whether these differences were innate or learned; the non-musician participants were studying psychology, law and physics and were therefore regularly practising their logical thinking skills, but may also have self-selected to these units on the basis of pre-existing skills. The authors of the study regarded the enhanced verbal memory skills of the musicians as part of a global cognitive style "that deals with simultaneous relationships and more global properties of patterns" (p. 132) - consistent with the holistic, intuitive nature of audiation (the imagination of sound structures and associated meanings).

If these findings are true of most music students and their professors, what are the implications for the content of music and music education curricula? One could argue that since the best musicians are best at global, intuitive thinking, the contents of the curriculum should be matched to that skill. The trouble with that approach is that musicians and music educators need the ability to think analytically in their everyday work. Like the

members of any other profession, the degree to which they possess that ability depends on the degree to which they use it. If young musicians are denied training in analytic thinking, they may always be deficient in it, which may negatively impact on their work as musicians or music educators, or their flexibility when it comes to changing professions or working across academic and practical disciplines.

The best way to enhance the existing analytical, logical thinking skills of music students is to encourage them to develop those skills in areas that are of direct relevance to them. In this paper, I have given several examples of such areas. Developing this ability will also help students to apply the findings of performance research to their own musical practice. A certain amount of analytic and logical thinking is necessary to understand the relationship between the methods and the findings of research projects.

Recommendations

The above considerations suggest that major post-secondary music institutions should, as far as possible within existing human and financial constraints, include relevant performance research in their curricula. Beyond compulsory introductions to music psychology and music performance research, curricula should include research-based electives (lectures, seminars, workshops, group teaching and so on) in areas such as:

Technical aspects of performance:

- physics, physiology, and psychology of performance on own instrument
- improvisation
- expression
- sight-reading
- memory
- intonation

Personal development and professional skills of the musician:

- motivation, practice, metacognition, self-efficacy
- performance anxiety and music medicine
- physical and psychological health and life balance

Students should be *required* to take *some* of these units, but have the freedom to choose among them. Consider a European Bachelor's curriculum comprising altogether 180 ECTS points (European Credit Transfer System) over three years of full-time study. If the listed units were worth 2 points each and students were required to take 5 of them, the set would be worth 10 points or 6% of the curriculum. If this proposal reduces the level of other, traditional subjects, it should only be realised if the shift of emphasis is likely to improve the overall efficiency of the curriculum. By "efficiency" I mean the ratio of desired output to input: the output is what students, teachers, administrators, politicians and the public want to achieve, and the input is the amount of time, effort and money that they invest.

For these goals to be achieved, it would be important to clearly define the objectives of each unit. It may not be enough simply to give a summary of relevant research and to try to apply this material to the needs of the individual students in practical exercises. For

example, the objectives of a unit on physics, physiology and psychology of piano performance might be to reduce the cognitive and physical load on the pianist, to free resources that can be used for expression and interpretation, and to develop the technical skills to achieve specific interpretive goals. An evaluation of the unit would investigate the extent to which such objectives were achieved.

Frequent objections

Because much of the relevant scientific (including psychological) research on music performance is quite recent, much of it has not yet found its way into the curricula of post-secondary music institutions. Eminent performance teachers are rightfully cautious of new developments, so a time lag between research developments and their implementation is normal and appropriate. The duration of the lag depends on how individual researchers who wish to teach these materials respond to critical resistance from performers. If researchers are to develop realistic, mutually acceptable strategies for curricular change, they must take the practitioners' objections seriously and adjust their pedagogical strategies accordingly. That may mean systematically documenting these objections and analysing accompanying arguments and related issues.

Objections based on academic content. Performance teachers may object that foreign ideas and teachers might interfere with the content and quality of their teaching and the teacher-student relationship. While this is a real danger, the counterarguments are equally strong:

- Great performers of the past and present generally had several different teachers, suggesting that this is a good strategy for all students.
- Students have rights and freedoms, including the freedom to seek out information from a range of sources.
- The research upon which the proposed units is based does not comprise "facts" or "truths", but rather *ideas* and *hypotheses* for which arguments generally exist on both sides. The proposed units will not "indoctrinate" students, if new ideas are presented together with arguments and evidence that both support and undermine them. An anti-positivistic approach trains students to evaluate arguments and decide for themselves what is likely to be true or useful for them.

Performance teachers may feel that the analytical approach of this kind of teaching inhibits musical spontaneity. They are right that analytical thinking is not always conducive to a good performance. Ideally, analytical thinking should be confined to practise; the main technical difficulties should have been solved before the performance. In reality, this is seldom the case and musicians on stage must often switch between relatively analytic thinking (in technically challenging passages) and relatively intuitive thinking (where they have mastered the technical problems and can focus on expression and interpretation). Seen from this point of view, training in analytic thinking should help musicians to consciously make that switch, both during practice and on stage.

Performance teachers may feel disempowered by their lack of familiarity with the content of the proposed units. Rather than admitting ignorance or any other lack of ability, which an artist on the free market is naturally reluctant to do, performance teachers may point out that they did not need this pedagogical material to rise to the top of their profession. Logically, their students should not need it, either. But the context of music and

music performance is constantly changing, so what was best for a teacher is not necessarily the same as what is best for her or his student; and no specialist in any area can possibly keep track of developments in all relevant areas - a problem that is becoming increasingly salient as the amount of research literature increases in all academic disciplines. One should not forget that students may end up being better than their teachers, and one could even argue that that should be the *aim* of every good teacher - if only because their students, if successful as performers, will be exposed to challenges to which they themselves were not.

Objections based on pedagogical tradition. Performance teachers may consider it unwise to change a successful pedagogical tradition: if it ain't broke, don't fix it. However, just because a pedagogical tradition is good, does not mean that it cannot be made even better, and a tradition that promoted excellence in the past may lead to mediocrity if it does not keep pace with changes in musical practice, pedagogy and culture. Every student generation is exposed to new influences and expectations to which post-secondary music institutions should be sensitive. One should therefore strive to be proactive - to anticipate future changes in artistic practice, social context and student expectations. Curriculum planners should regard the past and the future as equally important - however difficult it may be to respond adequately to the challenges and uncertainties of the future.

A common argument refers to the importance of a strong teacher-student relationship. For centuries, music education has resembled an apprenticeship in which the master shows the student the details of her or his craft. For this approach to work, the student must regard the teacher as an authority. The exaggerated esteem in which music students often hold their performance teachers may not be such a bad thing, since it motivates them to practise, which increases the amount of time they devote to practice - an important ingredient for success. To a large extent, this is true regardless of the content of the teaching. However, there is no reason why the incorporation of performance research into the curriculum should affect student-teacher relationships. Teachers can become actively involved in the units and discuss the content with their students both collectively and individually. Moreover, students will respect and value teachers who are open to outside influences.

A final important argument against the introduction of new units is that it is difficult to foresee the benefits in advance. Like every other objection, it is important to take this one seriously. Every new unit should be introduced first on a trial basis. It should be evaluated by both students and other experts and it should be clear that repetitions of the unit profit from the comments received on previous units.

Politics: Changing the System

It is not easy to introduce innovations of this kind in post-secondary music institutions with a long, strong tradition of musical excellence, for it is precisely these institutions that tend to be the most conservative. It is difficult to argue for change in a system that is already working well. How can your colleagues be sure that the innovation you are proposing is likely to lead to further improvement and will not endanger the high standard already achieved?

An important initial point is that change of some kind is inevitable, because the context in which post-secondary music institutions work is constantly changing. The academic con-

text is changing: post-secondary music institutions are under pressure to offer research degrees and support research projects, and performance research is constantly producing new findings that are adapted as the research is received by musicians. The political context is changing: educational institutions are increasingly expected to make their goals transparent and develop strategies to achieve them as cost-efficiently as possible. The sociocultural context is changing: children grow up in a world that is saturated with music of all kinds, which can devalue individual musical experiences; and musicians and educators are expected to be more flexible, changing musical styles and roles depending on cultural developments or the demands of the market.

Build on existing strengths. The quality of an educational institution depends on the balance between *focus* and *breadth* in its curricula. An excellent institution will specialise in one or more areas in which it excels by comparison to its competitors, and promote diversity (breadth) in other areas. New units should enhance either an existing focus or the general breadth of the curriculum.

Present evidence. When attempting to convince colleagues of the advantages of music performance research for post-secondary music institutions, it is important to focus on solid arguments and avoid unfounded opinions. There is plenty of research on the topics described in this paper that could be presented to colleagues (see reference list).

Understand colleagues' agendas. The success of any strategy for change will depend on the aims, needs, plans and aspirations of all involved people. How might they benefit from the proposed changes? What problems are they already trying to solve?

- *Performance researchers* may be divided into two categories. Some regard their research as "pure" and not necessarily of any practical use for musicians. Others believe that their research can make a positive contribution to music education. Researchers in the second category may be motivated by the possibility of realising that potential - provided that their contribution is indeed a positive one. They may - as I do - wish to strengthen their partnership with such institutions and to make a constructive contribution to their curricula and other activities on the basis of research findings.
- *Students* vary in their personal agenda, from those who are absolutely focused on their instrument and passionately want to succeed as performers to those who are curious about almost everything. Students are the main benefactors of the developments that I am advocating, but they often have little political power within their institution - even if they are represented on committees.
- While all *performance teachers* want the students in their class to succeed as performers, some may be sceptical that (additional) academic units may help them to achieve that aim - unless the benefits of a specific unit are demonstrated during some kind of trial followed by an appropriate form of evaluation.
- *Administrators* are interested in concrete success indicators that apply to the whole institution, enhance its reputation, and increase its chances of attracting funding from public and private sources. They may be amenable to arguments that additional units of the kind described here may, in the long term, contribute to improving success indicators. The main *visible* success indicators of a post-secondary music institution are its (inter-) nationally known graduate performers. But the vast majority of students do not make it to that level, suggesting that the main contribution of a post-secondary music institution to public life is *invisible*. Graduates of post-secondary music institutions (as well as many of the dropouts) organize, promote and coordinate all kinds of

musical activities at all kinds of levels, using the expertise - both practical and academic - that they acquired during their student years.

- The *general public* benefits from a rich cultural life across all social groups and strata - age, sex, income. It benefits from a stable, bright future illuminated by excellent, forward-looking institutions and active, capable, caring people. In a democracy, *politicians* should want much the same as the public that support them, insofar as the goals can be clearly stated and understood.

Understand democracy. A specific political problem that one encounters when trying to introduce new academic materials to a post-secondary music institution is the tension between two different democratic principles: *majority rules* and *minority rights*. Decisions made by high-level committees in post-secondary music institutions tend (rightly) to go in the direction of performers' wishes, because performers tend to represent the majority and performance is the main aim of the institution. The situation of the performers is strengthened further by the prevailing belief that the ability to perform is the most important prerequisite for good music tuition at the highest level. While that is certainly true, it is also true that good teaching involves not only high-level personal experience as a performer and sound teaching methods, but also academic knowledge that may involve quite different ways of thinking. Moreover, no one person can reasonably be expected to do both at an internationally competitive level. Thus, the minority rights of academics, theorists and composers should be respected in the interest of both artistic and academic quality - without losing sight of the main aim of training musicians and promoting music.

Revise the mission statement. A mission statement makes the goals of an institution transparent. The mission statement of a post-secondary music institution might begin by making it clear that music performance is the main goal of the institution, and that everything else that the institution does should be related to that goal. Thus, the institution might strive to promote the quality, quantity and diversity both of performed music and of musical training.

While such a statement might be perceived by performance teachers as promoting and defending their professional interests, other passages in a typical mission statement may not be viewed so positively. Performance teachers may feel that their artistic freedom is being limited by a statement that has been formulated by colleagues and administrators who have different goals and aspirations. In that case, they should have the opportunity to participate in a democratic process to reformulate the text.

One way of promoting the teaching of performance research in a music institution is to refer to it in the institution's mission statement. The inclusion of a specific goal in a mission statement is not a guarantee that the goal will be achieved, but it does improve chances considerably.

A mission statement can also refer to *interdisciplinarity*. The application of music performance research involves crossing a difficult boundary: that between research and practice. But there is another difficult boundary *within* music research, namely that between the humanities and the sciences, which should also be addressed. A post-secondary music institution that recognizes the difficulty of crossing such boundaries, and is prepared to support those that strive to do, is more likely to be able to apply academic research to its own benefit.

Optimise content and pedagogy. Academic units for music students should as far as possible be designed especially for music students, differing from units offered at regular universities in the following respects:

- They should avoid unnecessarily academic or technical language. Teachers should make a point of translating research jargon into the language that students use in their everyday work. This is not because musicians and music students are lacking in intellectual abilities; on the contrary, they tend to be practically oriented, constructively critical, courageous, impulsive, and suspicious of artificial sounding arguments or convoluted prose masquerading as “research”. They are more interested in the direct, transparent communication of logical sequences of practically oriented ideas.
- Theories should be presented in conjunction with specific examples to which the students can relate directly, such as a piece that one or more of them is currently playing. It is often best to begin with such an example and describe a specific problem associated with it before proceeding to develop a relevant theory; later, one can return to such examples, apply the theory to them, and develop specific applications, implications or strategies that demonstrate both the theory’s effectiveness and its limits.
- Teachers should be researcher-performers. They should not only contribute to research in the topic area of the unit, but should also perform music themselves at a level that will convince music students that they know what they are talking about from a practical point of view. They should be able to apply research results not only to the students’ specific practical issues but also to their own. Today, this criterion is becoming easier to meet due to the steadily rising number of musicians doing music performance research: their names can be found on the programs of recent conferences on music performance research and in the contents pages of this journal.

Inform and involve performance teachers. Units in the area of music performance research require considerable preparation. New content must be integrated, and new didactic methods developed. Moreover, the number of students interested in a given unit may depend primarily on the interest that can be generated amongst performance teachers before the unit begins. A new unit should be advertised well in advance, for example with an email that includes a link to an attractive, informative webpage; posters; an introductory event; and individual meetings with performance teachers. Meetings should take place early, because they invariably generate issues that individual performance teachers would like to see addressed. Such discussions can help the researcher-teacher to bridge the gap between the terminologies and epistemologies of research and practice, and can also inspire future research projects. Performance teachers are more likely to take part in research projects and associated teaching if they feel a sense of ownership. Thus, both projects and teaching should address issues that are of direct concern to performance teachers and their students, and the opinions and suggestions of both should influence the course of the research and the content of the teaching. But the participation of performers should not affect the amount of time that they have available for private practice and public performance.

Vary teaching format. Performance research, like any other academic content, may be presented to students in many different formats: isolated guest lectures or workshops, voluntary units for which the students can or cannot receive credit towards their degree, electives, or compulsory units. The research can also be presented to performance teachers, who may then be invited or inspired to incorporate aspects of it into their teaching. The wisest strategy would appear to be to aim for a diversity of presentation formats, as this gives students the widest choice and also provides an avenue for new topics to be accepted gradually into the curriculum. New materials can be introduced stepwise, starting with guest lectures, gradually proceeding to higher levels of institutionalisation, and pos-

sibly culminating in a compulsory unit.

Involve and empower students. Students are most likely to understand and be able to apply performance research if they are involved in it, either as participants or as members of research teams. However, students may not be ready for research until they reach honours or postgraduate level; and even then only those with academic ambitions tend to be seriously interested in research. Meanwhile, students can contribute to the acceptance of new units into the curriculum by evaluating them. It is already common for students to evaluate individual units, but they can also be asked to evaluate the whole curriculum. A *mentor system* can also be useful. Each student can be assigned to a specific member of staff (other than their main performance teacher) and encouraged to talk about issues relating to their curriculum and the choices that they have made within it. Students can talk to their mentors about the kinds of units they would like to see offered, and which units they consider too long, too difficult, or superfluous, and so on. Students can also make their preferences known through an elective system where they must complete, say, four out of ten offered units as part of the curriculum, and are also free to attend other units without receiving credit for them. Mentoring should allow students to express their opinions freely in the context of a constructive, non-hierarchical interaction with teachers and administrators. When it does, it gives the institution valuable information about how to improve its programs to suit the needs of the students. When students feel valued and identify with their institution, they are more likely to maintain contact after their courses are complete. And when they stay in contact, they can also be asked to evaluate the course retrospectively after they have entered professional life. What aspects of the course made a positive contribution to their careers?

Expand and diversify teaching staff. The permanent staff of post-secondary music institutions are often not in a position to teach materials of the kind presented here. Nor are they necessarily in a good position to have new positions created that cover these materials. New positions are expensive and must be supported by strong arguments. One way forward may be first to include some new subjects in the curriculum and have them taught by temporary staff. Once the success of the units can be demonstrated, it is time to make preliminary enquiries about the possibility of a new position, or a re-organisation of existing positions, such as a new relationship or affiliation with an external department such as psychology.

Musical interdisciplinarity

The ideas presented in this paper were inspired by a vision of musical and musicological interdisciplinarity (Parncutt, 2006). Every discipline, if left to itself, tends for practical reasons to specialise and avoid interaction with other disciplines. Crossing major interdisciplinary borders can be risky because one may not feel confident about one's abilities on the other side of the dividing line and because one's colleagues may not be in a position to appreciate interdisciplinary contributions. Music (-ology) is no exception: pianists tend to remain within musical practice, music historians within the humanities, and music psychologists within the sciences.

The research on expertise cited above confirms that it takes a lot of hard work to become an expert in a given discipline, which in turn suggests that no one person is capable of becoming an expert in more than one discipline. Instead, interdisciplinarity happens

when an expert in one discipline - say violin performance - works together with an expert in a contrasting discipline - say psychology. A prerequisite for such an interaction is constructive openness: one should respect not only the representatives of the other discipline as individuals, but also their ideas, conclusions and specific proposals - even when one does not fully understand the methods, traditions and intuitions behind them. One should neither believe nor reject everything, but instead aim for a middle path: an appropriate compromise between critical distance and unquestioning acceptance.

No member of a team of experts representing different disciplines should expect an individual to be an expert in two or more areas. Instead, all members should be genuinely curious about the approach and content of all disciplines relevant to their research question, and especially about other team members' corresponding knowledge. They should welcome and offer constructive criticism, and respect each other's disciplinary and personal positions. Thus, for example, music performance researchers must acquaint themselves thoroughly with the issues and values of the performers themselves - both teachers and students - if they are to succeed in making a positive contribution to their craft.

Post-secondary music institutions that develop a positive spirit of constructive interdisciplinary cooperation are, or will be, in a strong position to take advantage of recent research in music performance. But interdisciplinarity should not be regarded as an end in itself. It is only one of many strategies for training performers and promoting music, and as such should only be pursued insofar as it helps music institutions to achieve their practical musical goals.

Acknowledgments

I am grateful to Jane Ginsborg, Antonia Ivaldi and Gunter Kreutz for the invitation to speak at the conference "Teaching, Learning and Performing Music" at the Royal Northern College of Music, Manchester in July 2006, and for the subsequent invitation to submit this article. For much of my knowledge about the educational and practical aspects of this work, I am indebted to Gary McPherson, co-editor of the book "Science and psychology of music performance" (2002); Michele Biasutti, who invited me to speak on this topic at the International Symposium on Psychology and Music Education, Università di Padova, in November 2004, and to write up the contents for his book "Applicazioni educative della ricerca sull'esecuzione musicale" (2006); Aaron Williamon, my co-author for a paper on this topic at the conference "Performance Matters" in Porto, Portugal, in 2005; and Margit Painsi, my student assistant who made interesting comments on a draft of this paper and whose PhD project was a source of inspiration. For detailed, insightful comments I am grateful to Stacey Bartsch, Gunter Kreutz and Diana Weekes. Finally, the article was inspired by my graduate students in various areas of performance research: Charlotte Baumgartner, Elena Gasenzer, Werner Goebel, Patrick Holming, Karin Jost and Johann Lassnig.

References

- Altenmüller, E., Wiesendanger, M., & Kesselring, J. (Eds.) (2006). *Music, motor control and the brain*. Oxford, England: Oxford University Press.
- Barry, N. H., & Hallam, S. (2002). Practice. In R. Parncutt & G. E. McPherson (Eds.), *Science and psychology of music performance* (pp. 151-166). New York: Oxford University Press.

- Bigand, E., Poulain, B., Tillmann, B., & D'Adamo, D. (2003) Cognitive versus sensory components in harmonic priming effects. *Journal of Experimental Psychology: Human Perception and Performance*, *29*, 159-171
- Brandfonbrener, A. G., & Kjelland, J. M. (2002). Music medicine. In R. Parncutt & G. E. McPherson (Eds.), *Science and psychology of music performance* (pp. 83-96). New York: Oxford University Press.
- Brandler, S., & Rammsayer, T. H. (2003). Differences in mental abilities between musicians and non-musicians. *Psychology of Music*, *31*, 123-138.
- Csikszentmihalyi, M., and Rich, G. J. (1997). Musical improvisation: A systems approach. In K. R. Sawyer (Ed.), *Creativity in performance* (pp. 43-66). London: Ablex.
- Dweck, C. S. (1999). *Self-theories: Their role in motivation, personality and development*. Philadelphia: Psychology Press.
- Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, *100*, 363-406.
- Erlitz-Lanegger, E. (1997). *Funktionsgerechtes Körpertraining: Ein Handbuch für Lehrer, Kursleiter, Trainer*. Graz: Scientia.
- Ferguson, S., & Parncutt, R. (2004). Composing 'In the Flesh': Perceptually-informed harmonic syntax. *Proceedings of Sound and Music Computing* (Paris/France, 20-22 Oktober '00).
- Friberg, A., & Battel, G. U. (2002). Structural communication. In R. Parncutt & G. E. McPherson (Eds.), *Science and psychology of music performance* (pp. 199-218). New York: Oxford University Press.
- Gellrich, M. (1992). *Üben mit Lis(z)t-Wiederentdeckte Geheimnisse aus der Werkstatt der Klaviervirtuosen*. Frauenfeld: Im Waldgut.
- Gellrich, M., & Parncutt, R. (1998). Piano technique and fingering in the 18th and 19th centuries: Bringing a forgotten method back to life. *British Journal of Music Education*, *15* (1), 5-23.
- Goebel, W. (2001). Melody lead in piano performance: Expressive device or artifact? *Journal of the Acoustical Society of America*, *110*, 563-572.
- Howe, M. J. A., Davidson, J. W., & Sloboda, J. A. (1998) Innate talents: Reality or myth? *Behavioral and Brain Sciences*, *21*, 399-407.
- Jost, K. (2004). *Unterstützende Methoden beim Erlernen der traditionellen Notation im Instrumentalunterricht mit Kindern*. Diplomarbeit, University of Graz.
- Juslin, P. N., & Persson, R. S. (2002). Emotional communication. In R. Parncutt & G. E. McPherson (Eds.), *Science and psychology of music performance* (pp. 219-236). New York: Oxford University Press.
- Kemp, A. E. (1996). *The musical temperament: The psychology and personality of musicians*. New York: Oxford University Press.
- Kenny, B. J., & Gellrich, M. (2002). Improvisation. In R. Parncutt & G. E. McPherson (Eds.), *Science and psychology of music performance* (pp. 117-134). New York: Oxford University Press.
- Kenny, D.T., & Ackermann, B. (in press). Anxiety in public performance, stress and health issues for musicians. In S. Hallam, I. Cross, & M. Thaut (Eds.). *Oxford Handbook of Music Psychology*. Oxford, UK: Oxford University Press
- Krumhansl, C. L. (1990). *Cognitive foundations of musical pitch*. Oxford, England: Oxford University Press.
- Larson, S. (2004). Musical forces and melodic expectations: Comparing computer models

- with experimental results. *Music Perception*, 21, 457-498.
- Lassnig, J. (2004). *Theorie und Praxis der Kreativität als Grundlage einer Improvisations-Didaktik im Jazz-Unterricht*. Diplomarbeit, Kunstuniversität Graz.
- Lehmann, A. C., Sloboda, J. A., & Woody, R. H. (2007). *Psychology for musicians: Understanding and acquiring the skills*. Oxford, England: Oxford University Press.
- McPherson, G. E. (Ed.) (2006). *The child as musician: A handbook of musical development*. Oxford, England: Oxford University Press.
- McPherson, G. E., & Gabrielsson, A. (2002). From sound to sign. In R. Parncutt & G. E. McPherson (Eds.), *Science and psychology of music performance* (pp. 99-116). New York: Oxford University Press.
- Mornell, A. (2002). *Lampenfieber und Angst bei ausübenden Musikern*. Frankfurt: Lang.
- Odam, G., & Bannan, N. (Eds.) (2005). *The reflective conservatoire: Studies in music education*. London : Guildhall School of Music & Drama.
- O'Neill, S. A., & McPherson, G. E. (2002). Motivation. In R. Parncutt & G. E. McPherson (Eds.), *Science and psychology of music performance* (pp. 31-46). New York: Oxford University Press.
- Painsi, M. (2004). Wie erklären Schüler ihre musikalischen Erfolge und Misserfolge? *Musikerziehung*, 5, 235-242.
- Painsi, M. (2007). *Motivations- und Stressmanagementtraining für Schüler an Musikschulen mit Lehrerbeteiligung*. Dissertation, University of Graz, Austria.
- Parncutt, R. (1989). *Harmony: A psychoacoustical approach*. Berlin: Springer-Verlag.
- Parncutt, R. (2004). Enrichment of music theory pedagogy by computer-based repertoire analysis and perceptual-cognitive theory. In J. W. Davidson & H. Eiholzer (Eds.), *The music practitioner: Research for the music performer, teacher and listener* (pp. 101-116). London, England: Ashgate.
- Parncutt, R. (2003). Accents and expression in piano performance. In K. W. Niemöller (Ed.), *Perspektiven und Methoden einer Systemischen Musikwissenschaft* (pp. 163-185). Frankfurt/Main, Germany: Peter Lang.
- Parncutt, R. (2006). Interdisciplinary musicology. Foreword to *Musicae Scientiae*, special issue 2005-2006 "Interdisciplinary musicology", 7-11.
- Parncutt, R., & Holming, P. G. S. (2000). Is scientific research on piano performance useful for pianists? Poster and abstract at *International Conference on Music Perception & Cognition* (Keele, England, July).
- Parncutt, R., & McPherson, G. E. (Eds., 2002). *The science and psychology of music performance: Creative strategies for teaching and learning*. New York: Oxford University Press.
- Parncutt, R., Sloboda, J. A., Clarke, E. F., Raekallio, M., & Desain, P. (1997). An ergonomic model of keyboard fingering for melodic fragments. *Music Perception*, 14, 341-382.
- Porter, G. (1996). Organizational impact of workaholism: Suggestions for researching the negative outcomes of excessive work. *Journal of Occupational Health Psychology*, 1, 70-84.
- Rink, J. (Ed.) (2002). *Musical performance, A guide to understanding*. Cambridge: Cambridge University Press.
- Schlaug, G., Jäncke, L., Huang, Y., Staiger, J. F., & Steinmetz, H. (1995). Increased corpus callosum size in musicians. *Neuropsychologia*, 33/8, 1047-55.
- Spence, J. T., & Robbins, A. S. (1992). Workaholism: Definition, measurement and pre-

- liminary results. *Journal of Personality Assessment*, 58, 160-178.
- Temperley, D. (2001). *The cognition of basic musical structures*. Cambridge, MA: MIT Press.
- Tillmann, B., Janata, P., Birk, J. & Bharucha, J. J. (2003). The costs and benefits of tonal centers for chord processing. *Journal of Experimental Psychology: Human Perception and Performance*, 29 (2), 470-482.
- Williamon, A. (2004). *Musical excellence: Strategies and techniques to enhance performance*. London, England: Oxford University Press
- Williamon, A., & Thompson, S. (2006). Awareness and incidence of health problems among conservatoire students. *Psychology of Music*, 34, 411-430.
- Wilson, G. D. (2002). *Psychology for performing artists* (2nd ed.). London: Whurr.
- Wilson, G. D., & Roland, D. (2002). Performance anxiety. In R. Parncutt & G. E. McPherson (Eds.), *Science and psychology of music performance* (pp. 47-62). New York: Oxford University Press.
- Woody, R. H. (1999). The relationship between explicit planning and expressive performance of dynamic variations in an aural modeling task. *Journal of Research in Music Education*, 47, 331-342.
- Wright, D. (2005). The South Kensington music schools and the development of the British conservatoire in the late Nineteenth Century. *Journal of the Royal Musical Association*, 130(2), 236-282.

Richard Parncutt is Professor of Systematic Musicology at the University of Graz, Austria. His research addresses musical structure (pitch, consonance, harmony, tonality, melody, counterpoint, tension, rhythm, meter, accent), performance (psychology, piano, applications), the origins of tonality and of music, and musicological interdisciplinarity. He holds qualifications in music and physics from the University of Melbourne and a PhD from the University of New England. He was guest researcher with Ernst Terhardt in Munich, Johan Sundberg in Stockholm, Annabel Cohen in Halifax, Al Bregman in Montreal, and John Sloboda in Keele, England. Until 1998 he was lecturer at the University of Keele.