

TRAINING FOR SUSTAINED PERFORMANCE: MOVING TOWARD LONG-TERM MUSICIAN DEVELOPMENT

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TRAINING FOR SUSTAINED PERFORMANCE: MOVING TOWARD LONG-TERM MUSICIAN DEVELOPMENT**Abstract**

Success in sports, like the performing arts, is dependent upon the acquisition and consistent use of a diverse range of skills. Additionally, an understanding of safe and effective use of the body is required to facilitate long-term involvement in that activity. In order to assist athletes to attain their performance goals, and ensure healthy and sustained involvement, long-term athlete development (LTAD) models have been devised and adapted by professional sporting bodies throughout the world. LTAD models emphasize the intellectual, emotional, and social development of the athlete, encourage long-term participation in physical activities, and enable participants to improve their overall health and well-being and increase their life-long participation in physical activity. At present there is no such long-term development model for musicians. Yet musicians must cope with a multitude of career-related physical and mental demands and performance-related injuries and career burnout are rife within the profession. Despite this, musicians' training rarely addresses such issues and musicians are left largely to learn about them through either chance or accrued experience. This paper discusses key concepts and recommendations in LTAD models, together with music-specific research highlighting the need for the development of a comprehensive long-term approach to musicians' training. The results of a survey of existing music training programs are compared to recommendations and the different development stages in LTAD models. Finally, implementation science is introduced as a methodological option for identifying how best to communicate the body of evidence-based knowledge concerning healthy and effective music-making to young student musicians.

Classical music performance is an intensely competitive field and only a select few will be able to attain a successful career as a performing musician. Success depends not just on the acquisition of the necessary technical and expressive skills, but developing and sustaining a performing career also requires a range of skills encompassing effective practice and training routines, methods for preparing for and coping with the physical and mental strains associated with performing, and understanding long-term care of the body to withstand such strains¹.

In pursuit of this, it is not uncommon for children as young as 3 or 4 years of age to commence studies on the piano or violin and begin lengthy practice routines. This likely stems, at least in part, from theories on the acquisition of expertise such as the 10-year rule² and the perception that the earlier a musician begins serious studies the further ahead they will be when it matters (i.e. adolescence, when they start auditioning for specialist music schools, competing in competitions and festivals, etc.). Consequently, music performance could be considered an early-specialization activity. However, a growing body of research within sport is starting to identify potential physical and psycho-social consequences associated with early specialization in an activity³. These can include the stifling of sociological and psychological development⁴, increased incidences of physical injuries due to excessive training during crucial periods of biological development⁵, reductions in self-reported overall health⁶, heightened occurrence of staleness⁷, dropout⁸ and burnout⁹, and a higher prevalence of eating disorders among sports with aesthetic requirements such as dance and gymnastics¹⁰. Many of these issues are not uncommon within music.

Additionally, the multitude of negative health problems that can result from sustained and intensive engagement in music performance, beyond the early years, are becoming increasingly acknowledged^{11,12}. In response to this, there has been growing interest in studying the kinds of health problems common within the performing arts and ways of

treating or managing them. There is also increased attention being directed towards preventative work. Related initiatives include injury screening programs, health awareness and education workshops, and curriculum-based courses for musicians¹³⁻¹⁷.

Although rather ambitious, one possible response to the above described situation is for the performing arts community as a whole to reconsider the way in which training is provided to artists at all ages and levels of their development, as has been occurring within the sporting world over recent years. Success in sports, like the performing arts, is dependent upon the acquisition and consistent use of a diverse range of training, competition, and career-management skills. Moreover, an understanding of safe and effective use of the body is required to facilitate long-term involvement in that activity.

To assist athletes to attain their performance goals, and ensure healthy and sustained involvement, training programs based upon what are termed long-term athlete development (LTAD) models are emerging¹⁸⁻²⁰. Originally conceived in Canada, sporting organizations around the world are now adapting and implementing their own versions of these models to inform athlete development.

At present there is no such long-term development model for musicians, nor such a structured approach towards musicians' training more generally. As discussed above, performance-related injuries and career burnout are rife within the music profession. Despite this, musicians' training rarely addresses such issues and musicians are left largely to learn about them through either chance or accrued experience. Coincidentally, there is a growing call within dance that teachers review, and potentially revise, the ways in which dancers are currently being trained²¹. In a recent interview²², William G. Hamilton, MD, advocates for a more pro-active approach to prevent overuse injuries in young dancers and address the 'more is better' climate that exists within the performing arts.

This paper will begin by discussing key concepts and recommendations in LTAD models and what they have to offer for musicians' training. Empirical music-specific findings that highlight the need for the development of a comprehensive long-term approach to musicians' training will be examined. A survey of existing programs and modes of music training will be presented, including those for young children as well as typical conservatoire-style training. These will be compared to recommendations and the different stages in LTAD models in order to identify similarities, overlaps, and potential gaps in typical musician training. Finally, implementation science will be introduced as a methodological option for identifying how best to communicate the body of evidence-based knowledge concerning healthy and effective music-making to young student musicians. The potential benefits to musicians' health and well-being and career longevity as a result of adopting a comprehensive, long-term approach to musicians' training will be highlighted throughout.

LTAD rationales, concepts, and structure

A recent inquiry into sporting within Canada noted the poor international standards of performance within many sports¹⁸ (i.e. low Canadian medal counts at international competitions). The inquiry also highlighted a number of other issues, including a high prevalence of sport-related injury, lack of overall proper fitness, and athletes exiting from the sport and not returning, particularly those aged 14-17 years old. The initial inquiry¹⁸ and subsequent discussions²³ concluded that these issues were occurring, at least in part, due to widespread employment of sub-optimal or misguided training methods that included:

- Training programs that emphasised over-competition and under-training
- Adult training and competition programs superimposed on children

- Employing a ‘Peaking by Friday’ approach that focused on short-term performance achievements rather than long-term skill development
- Training based upon chronological age versus developmental age
- Training programs that would often miss the ‘windows’ of accelerated adaptation
- Physical literacy not taught – only single sporting activities taught
- The most knowledgeable coaches typically working with elite athletes while the coaches who work with children (while potentially enthusiastic and well-meaning) often do not have the same depth of knowledge
- Parents not educated or aware of how to appropriately support young developing athletes

In response to these and other issues relating to sports activities in Canada, Canadian Sport for Life produced what is termed a Long-Term Athlete Development (LTAD) model¹⁸⁻²⁰. The initial documents describing the LTAD model and theories were intended to act as a catalyst to inspire sporting organizations throughout Canada into discussion and action relating to the situations surrounding sport participation and success, as well as physical activity levels more generally. In addition to the reasons outlined above, LTAD was developed also in response to a decline in participation in recreational sport and physical activity and the marginalization of physical education within schools.

Key concepts and theoretical bases of LTAD

The original concept of LTAD was developed in order to assist athletes to attain their performance goals and ensure healthy and sustained involvement. Consequently, LTAD models have been devised and adapted by professional sporting bodies throughout the world. LTAD models are based around stages of physical and mental development and windows of

optimal trainability in children and youth²⁴. As well, they are underpinned by the premise that “A specific and well-planned training, competition, and recovery regime will ensure optimum development throughout an athlete’s career” (p. 7)²⁵. By striving to provide athletes with structured, systematic instruction in technical, training, and performance skills, LTAD models promote long-term development and performance success, as well as supporting health and wellbeing throughout an athlete’s career. LTAD emphasizes the intellectual, emotional, and social development of the athlete, encourages long-term participation in physical activities, and enables participants to improve their overall health and well-being and increase their life-long participation in physical activity. As a result, LTAD promotes a healthy, physically literate nation, whose citizens participate in life-long physical activity¹⁸. It is intended that the varied activities advocated within the earlier stages of LTAD models help prevent early burnout, dropout, and retirement that could possibly result from intensive engagement in activities. Again, these issues are not uncommon within music.

Table 1 below describes the 7-stage LTAD model (names of the stages and key objectives for each stage from Balyi et al.²³; some text from Balyi et al.²⁵; early specialization ages obtained from the Figure Skating LTAD model²⁶). Sports are typically considered to be either early- or late-specialization sports. Consequently, the average ages at which children pass through the stages will differ between early and late specialization; the ages for both types are listed in the table. It is worth noting that there are some variations between the names of the different stages and the ages for each between different sport adaptations. However, all sport adaptations are based upon the same fundamental principles.

Insert Table 1 about here

In addition to their focus on structuring training around stages of physical and mental development and windows of optimal trainability, LTAD models are also unique in that they advocate for the use of comprehensive, multi-faceted training programs. Diverse training is designed to ensure that athletes are equipped with the range of skills required to make certain that not only are they successful within the performance arena, they are able to maintain their physical and mental health while pursuing their performance goals and are more likely to enjoy sustained involvement in their sport. Consequently, the various groups of skills commonly addressed within LTAD training models include non-specific gross and fine motor skills, activity-specific technical skills, physical fitness, mental training and psychological skills, training and tactical/competition-specific skills, and interpersonal and social skills.

The music research scene

Developing musical talent

There is no shortage of research and writing on issues surrounding musical development. This body of research comments on topics including early musical engagement^{27,28}, engaging in music lessons and commencing serious or dedicated musical studies²⁹, the acquisition and refinement of musical skills and literacies^{30,31}, and attempts to define phases of musical development³². The relevance of practice in the development of musical proficiency cannot be overstated. Indeed, a number of studies have confirmed the influential role that the quantity^{2,33} and quality³⁴⁻³⁸ of a musician's practice can have on their later performance achievements.

However, there is a significant difference between learning to play an instrument, even if one aspires to play that instrument to an incredibly high standard, and being able to reach and maintain a successful career as a performing musician. Interviewing 29 conservatoire and professional musicians, Clark³⁹ identified a range of musical, performance-

related, and psychological skills deemed necessary by musicians for a successful career in music performance (see also Clark et al.¹ for discussion). Musical skills included aspects such as technique, musicality, and interpretation. The musicians also discussed a range of more performance-focused skills, as well as interpersonal and professional skills. Performance-focused skills included being able to express emotion and project stylistic ideas during performance, communicate with an audience, and understand how to adjust effectively to the acoustic response of a performance space. Psychological skills, meanwhile, encompassed skills such as focus, confidence, and motivation, as well as the knowledge and use of a range of strategies relating to practice, performance, and over-all learning and progression. While not necessarily a skill in and of itself, the importance of looking after one's physical and mental health was also highlighted. It becomes apparent that musicians consider a successful career in music performance to be dependent upon a far broader range of skills than just a high level of technical facility with their instrument and musical expression and understanding.

To demonstrate the process of attaining a successful career in music performance, Gagné⁴⁰ offers a revised version of his Differentiated Model of Giftedness and Talent (DMGT^{41,42}; see McPherson & Williamon⁴³, for a version of the model adapted for music) which outlines his developmental theory for the transformation of gifts into talents. On one side of this model, Gagné proposes a list of domains of ability, or gifts, that he feels are inherent in every person, to varying degrees. These domains include intellectual, creative, socio-affective, and sensori-motor, all of which further involve their own different types of abilities. On the other side of the model, these abilities can then be translated into fields of performance, or talents. In order for these talents to emerge, however, they must pass through a developmental process that is influenced by three factors: intrapersonal catalysts, environmental catalysts, and chance. Rather than the potential presence or absence of latent

ability, Gagné's⁴⁰ model suggests that it is these three areas which exert the greatest influence over the actualization of talent. Consequently, those in charge of musicians' training will no doubt be most interested in what happens during this developmental process and how best to structure it. This becomes very relevant in terms of defining the most efficient format and content of such training in order to ensure optimal development and preparation for a successful musical career.

To help ensure successful progression through the developmental process and the realization of high level sport-specific talents, many sporting organizations have adapted their own version of LTAD models. Such models provide guidance to coaches and others involved in the training of young athletes as to how best this process might be achieved. It would appear logical that a model of this kind could therefore help those involved in musicians' training understand and apply what would best help musicians acquire the requisite skills for a successful performance career.

While assisting musicians to attain their performance and musical goals is, and likely will for some time be, of particular importance and concern for those involved in their instruction, training programs for musicians need to be designed to ensure that musicians can also enjoy a long and healthy engagement in their musical activities as well.

Physical and mental demands of performance

Performance-related health problems are widely prevalent throughout the music profession, both at the student and professional level¹². Surveys have suggested that between 37-85% of musicians will be injured at some point in their careers⁴⁴⁻⁴⁶. A large survey of musicians from 57 orchestras worldwide found that 56% had suffered playing-related pain within the previous year and that 34% of those surveyed experienced pain more than once a week¹¹. An investigation involving UK music conservatoire students indicated that musculoskeletal and

non-musculoskeletal problems are common, with approximately half of the 246 participants reporting having experienced at least one playing-related injury within the past year⁴⁷. It is particularly significant in terms of musicians' awareness of health issues that an inverse relationship between injury frequency and perceived practice and performance quality also emerged from this study⁴⁷.

Anxiety, both as a personality trait and related to specific situations, is common in musicians⁴⁸ and has been acknowledged to influence the likelihood of physical as well as psychological injury and susceptibility to musicians' dystonia^{49,50}. Similarly, it has been suggested that stress hardiness, or a musicians' ability to cope with stress, can moderate their susceptibility to injury and performance anxiety⁵¹. Indeed, the severity of adolescent musicians' vulnerabilities to audition stress, and the levels of such stress, has been highlighted⁵². Consequently, there is a body of research that emphasizes effective physical preparation for the musical 'athlete'⁵³ and health education for the music student⁵⁴.

In addition to the startling prevalence of physical and mental health concerns among those in the music profession are music students' attitudes toward and limited understanding of health promotion. A survey conducted at two UK conservatoires found that music performance students show greater concern for psycho-social over physical aspects of their own health and that they are particularly neglectful of health responsibility⁵⁵. Additionally, music performance students have been found to score lower in terms of health promoting behaviours than non-performance students on health responsibility and physical activity⁵⁶. Potentially compounding this is music students' typical method of gathering health information. Research has noted that studio teachers are often the first port of call when a student is seeking information on health issues, despite the fact that those studio teachers may not necessarily have adequate training to dispense such advice⁵⁴.

Given the high levels of physical, mental, and emotional demands required in music performance, this is particularly troubling. There has been considerable progress in the diagnosis and treatment of musicians' injuries, as evidenced by the generic and instrument-specific research-based literature that now exists⁵⁷⁻⁶⁰. However, proactive prevention of injury is limited largely to attempts to manage practice and performance in ways that will cause the least amount of strain.

Although all of the above is considered relevant to a musical career, musicians' training remains based largely upon experience and tradition rather than scientific evidence and principles that might be able to address these prevalent health and well-being implications. There is the issue of course that many musicians likely perceive themselves as artists rather than athletes, potentially due to the intellectual and emotional demands required by music performance⁶¹, and are hesitant to consider or acknowledge the value of applying scientific findings to their training¹³. That said, in his study of 57 orchestras worldwide, James¹¹ notes that 83% of respondents reported that they felt their training have left them unprepared to deal adequately with the demands of their profession.

Existing programs and modes of music training for children and youth

Survey of current programs

The research discussed in the above section would suggest that the manner in which musicians are trained should be reviewed and potentially changed to become more comprehensive. Prior to advocating for change, however, it is worth first briefly surveying training programs currently in use for musicians to gain insight into what might be contributing to this apparent gap between research on healthy and effective musical development and music students' awareness and understanding of the findings from such research. To this end, the paper- and web-based prospectuses of 13 leading music

conservatories, schools, and universities throughout North America, Europe, and Austral-Asia were surveyed to develop an awareness of the kinds of music programs currently offered for children and youth (survey conducted January-February 2012; for a list of the institutions included in the survey, and a summary of survey findings, see Appendix A: Survey of existing programs and modes of music training).

The survey indicated that most institutions offer two main types of programs, the first being those for young children. Many programs for young children involve a combination of music and movement and are based upon principles from the Orff, Kodaly, and Dalcroze methods. While not all institutions offer rationales for these programs, one of the best was provided by the Mount Royal Conservatory in Canada: “The early childhood programs promote confidence and self-esteem, increase focus and concentration, increase physical and aural awareness, and foster an appreciation and love of music and language, and a life-long desire to learn” (retrieved on May 21, 2012, from: http://www.mtroyal.ca/ProgramsCourses/FacultiesSchoolsCentres/TheConservatory/ChildrensPrograms/cons_musicwithbaby.htm). It is worth noting how far down this list one has to go before there is mention of music-related skills, and even that reference is limited to “an appreciation...of music and language”. This quote would suggest that such classes employ music as a method for more general child development as opposed to focusing on the development of musical skills in a child. This important distinction has been raised by Pruett⁶² who stresses that, when choosing music programs, parents would be wise to consider their child’s development as a child first and a musician second. Indeed, the range of potential intellectual, social, and personal development opportunities that can arise from children’s early engagement with musical activities has been well documented²⁸. Many of the institutions in the survey highlighted the physical, cognitive, intellectual, emotional, and social developmental benefits that could result from participation in their particular programs (see survey results in Appendix A). This also concurs with

Pruett's⁶² recommendation that early childhood music classes focus on the broad development of children. Given the amount of research advocating this, it is very promising to note in the survey results the number of music schools that do offer programs for young children that have this particular focus; a rare example of research and practice in agreement!

The second type of commonly offered programs are Junior Department-type programs. The age range for these differs considerably between institutions. For instance, Manhattan School of Music starts their program for students as young as 5 years of age. Australian National University, meanwhile, just offers a program for students aged 16-18 (students in Years 11 and 12 at school) while Nanyang Academy of Fine Arts offers their 'Access Course' for students during a gap year between high school and university (students would typically be aged 18-19). Essentially, many of these programs appear to offer similar types of content. Typically, the programs offer private lessons, music theory and history classes, aural and sight-singing skills, opportunities to play in large and small ensembles, and solo and ensemble public performing. Nothing is mentioned about performance skills, let alone anything to do specifically with the physicality and psychology of music making and performance.

Current training programs compared with LTAD models

As highlighted in Appendix A and the above section, many institutions offer early childhood music classes that have an emphasis on introducing children to music with a particular focus on fun, play, and movement. A number of such classes also introduce children to basic musical concepts such as scales and rhythms. These kinds of classes would appear to relate quite closely to the 'Active Start' and 'Fundamentals' stages in LTAD models and help children develop basic motor skills as well as providing an introduction to basic technical music skills (see Table 1 for LTAD stages). This would provide children with a solid base of

fundamental movement patterns and fundamental music-specific skills; significant prerequisites to intense engagement in any activity.

From there, though, children who want to begin private lessons and learn a particular instrument enter into programs that place an emphasis on learning a single (or maybe two) instrument(s) and are provided with training in specific musical and instrumental skills (for further details of program content see Appendix A). While such training programs often provide great detail on the mechanics of playing instruments together with issues surrounding interpretation (technical and artistic skills), the results of the survey would suggest that young musicians are not necessarily provided with formal instruction in effective practice methods, performance-related skills, or techniques to promote long-term physical and mental health and well-being such as would be relevant both within and outside of musical activities (such as is addressed within Stages 4, 5, and 6 of the LTAD model; see Table 1).

Interestingly, should young musicians choose to continue their studies in, and become accepted into, a post-secondary conservatoire or university music program, at that point they might start to receive more comprehensive training. Multi-faceted courses on a wide range of performance skills are becoming more common and an increasing number of conservatoires and universities now offer programs and support surrounding musicians' health and well-being^{15,63,64}. While it is great that such courses and initiatives exist, many students entering tertiary-level music training will typically have already accrued 10-15 years of intense engagement with musical activities. As highlighted above, there is a good chance that, unless their individual studio teacher took a broad approach to their training, their earlier musical instruction would largely be limited to technical training on how to play their instrument. This is particularly problematic given the popularity for young musicians to participate in festivals and competitions, audition for youth orchestras, tour with orchestras should they have won a concerto competition, and ultimately audition for limited places in highly

competitive music schools. Clearly, many young musicians' engagement with music extends far beyond what would be involved were it a pastime or hobby; their engagement can be very intense in terms of the physical, mental, and emotional demands required by their practicing and performing activities. However, it would appear that young musicians are not being equipped with the skills and knowledge, much of which currently exists in the research literature, to cope with these demands effectively and healthily.

Implementing the research

All of this appears to be leading to a troubling situation. Our understanding of the physical and mental demands associated with music performance is developing^{59,60}; the field of performing arts medicine is expanding, clinically and academically⁶⁵. Some of this knowledge is making its way from medical and research domains to professional and student musicians via a growing number of performance skills-type courses currently offered at universities and conservatoires around the world. However, the results of the survey reported earlier (details provided in Appendix A) would suggest that little of this information and knowledge is getting imparted to children and youth, at least not in any formal or structured manner. Intriguingly, current systems of musical training introduce children to music at a young age. If the child's interest in music continues, they typically commence formal instrumental or vocal lessons in which they are taught the mechanics of playing (technique and interpretation) and receive instruction in areas such as music theory, history, and aural and sight-singing skills. Following this phase, if the child (now late adolescent) chooses to study music performance at the tertiary level, only at this point are they finally taught how to engage in musical activities safely and effectively. By this point, however, poor technique and practice habits may be well ingrained and the musician's susceptibility to performance-related health problems elevated. Highlighting the severity of this issue, a large-scale study of

1046 musicians seen at clinics run by the British Association for Performing Arts Medicine notes that the musicians themselves attributed their problems most commonly to ‘doing it wrong’ (e.g. poor posture, bad practice technique, lack of fitness, and stress)⁴⁵.

Rectifying this situation will no doubt require a shift in thinking in terms of how those who run music programs for children view themselves and their school’s activities.

Brandfonbrener⁶⁴ (p. 1) comments that:

“Music schools in the past regarded their role as making available the best possible training for their students, so that these students could become skilled, competitive, and successful in their musical careers. However, music schools have come to recognize that their institutions have injured students in large numbers, leading these schools to confront the necessity of redefining their roles to include a responsibility for students’ health.”

That some music schools do indeed still consider their role as training skilled, competitive, and successful musicians, and the potential implications of this mentality on musicians’ learning experiences, is well examined by Perkins⁶⁶. However, research within the fields of performing arts medicine and the physicality and psychology of music making are producing a wealth of information about healthy and effective musical engagement that can be passed along to musicians. Additionally, university- and conservatoire-based courses are trialling and evaluating methods for imparting this knowledge to students. What is needed now is a greater understanding of how best to communicate this knowledge to musicians at all levels of development, but particularly children and youth in the early stages of their musical learning. The LTAD concept and models discussed above offer one such framework for how to equip young musicians with the broad skill sets required for long-term healthy and effective musical engagement. However, there is the very real issue that just because a type

of program may have been successful for use with athletes (such as LTAD models), that does not guarantee that it would be appropriate for musicians⁶⁷.

As well, simply having a model such as the LTAD does not necessarily guarantee effective use of that model. Research within sports that currently employ an LTAD model has demonstrated that, while participants in those sports appreciate having a development model in place, concerns can still exist regarding the extent and effectiveness to which the development model and accompanying program are implemented⁶⁸. Any such model, regardless of uptake from the community, will no doubt require continuous evaluation to ensure maximum efficacy^{69,70}.

No doubt there are a number of questions that would need to be addressed in order to create and begin implementing a music-specific long-term development model. In general, these would relate to the potential structure, content, and mode of delivery of the model.

More specifically, such questions could include:

- Would a staged model of development (and approach to training) apply to or be appropriate for musicians? If so, what might the different stages, and number of stages, be?
- What specific content should be included within the different stages?
- What would be the best way to deliver the training to musicians? How could musicians' training programs be designed to incorporate these elements?
- Given that musicians' training is already an intense process filled with many hours of practicing, would it even be possible to insert more content and information into their training and still produce technically skilled players?

One possible approach to addressing these questions is the use of an implementation science or research methodology. As defined by the journal *Implementation Science*, implementation research is:

“the scientific study of methods to promote the systematic uptake of proven clinical treatments, practices, organisational and management interventions into routine practice, and hence to improve health. In this context it includes the study of influences on patient, healthcare professional and organisational behaviour in either healthcare or population settings.... Further, it is scientifically important because it identifies the behaviour of healthcare professionals and healthcare organisations as key sources of variance requiring improved empirical and theoretical understanding before effective intervention can be reliably achieved” (retrieved on June 4, 2012, from <http://www.implementationscience.com/about>).

Implementation science developed in response to the growing awareness that knowledge, and the guidelines for best practice that sometimes arise from that knowledge, is not necessarily sufficient to stimulate behaviour change. This methodology encourages researchers to examine the social, cultural, and material contexts that might influence the responsiveness to and uptake of new ideas within a particular community of practice⁷¹. Consequently, when developing and delivering an intervention or training program, implementation science advocates for an initial assessment of the overall context within which the intervention will be delivered. For example, Damschroder et al.⁷² discuss the Consolidated Framework for Implementation Research which comprises five key areas that warrant consideration when conducting implementation research:

- 1) The intervention itself: the source of the intervention, the evidence upon which it is based, adaptability to different contexts, trialability, and complexity

- 2) Outer setting: patient needs, cosmopolitanism of the field or community, peer pressure, external policies
- 3) Inner setting: structural characteristics of the organization or community, networks, culture, climate
- 4) Individuals involved: existing knowledge and beliefs regarding the intervention, self-efficacy, individuals' stage of change, identification with organization
- 5) Process: planning, engaging, executing, reflecting and evaluating the intervention

This assessment is then used to inform the development, delivery, and evaluation of the intervention, rather than just focusing solely on the outcomes of the intervention or training program when measuring its effectiveness.

The impact that a context or environment can have upon an individual's and group's responsiveness to novel interventions or training has been examined extensively by Bronfenbrenner in the development of his ecological systems theory⁷³. Bronfenbrenner proposes that in order for an individual to be fully understood, an understanding of their greater ecological environment is essential. Within music, Welch⁷⁴ describes this as a Russian Dolls-type scenario. Commonly held beliefs or behaviours at any of these levels can have a significant impact upon a musician's own beliefs and behaviours. Not only is it important to develop an understanding of the beliefs of an individual musician prior to the development and delivery of a novel training program, such as one addressing health and well-being, an awareness of the context within which the training will take place is also essential for effective delivery. Indeed, Welch⁷⁵ advocates for the development of a multi-faceted, holistic perspective in order to understand how musical learning occurs. This aligns with Jørgensen's⁷⁶ recommendation that research is needed to explore the institutional culture of conservatoires.

A series of related studies have been conducted by Burt-Perkins and colleagues to expand the understanding of how musicians learn^{66,77-81}. Their work has focused on the broader context of musicians' learning, stressing the importance of the entire learning culture, which can encompass some of the points discussed by Damschroder et al.⁷² above. The importance of the community of practice has also been highlighted by Nielsen⁸² who suggests that conservatoire training resembles an apprenticeship or master learning approach. By examining the learning culture within which a musician is trained, Burt-Perkins⁸⁰ proposes that researchers will be in a position to determine more clearly the impact the learning environment has upon students' experiences and the potential influence of that upon the delivery of and responsiveness to novel evidence-based knowledge.

In terms of the actual *doing* of implementation science, Bhattacharyya et al.⁸³ offer a seven-step process for its use when developing and evaluating an intervention or training program:

- 1) Identify care gaps and the need for change
- 2) Identify barriers to the consistent use of guidelines
- 3) Review evidence or implementation interventions
- 4) Tailor or develop intervention to improve performance
- 5) Implement intervention
- 6) Evaluate process of implementation
- 7) Evaluate outcomes of intervention

Taken together with Damschroder et al.'s⁷² Consolidated Framework for Implementation Research discussed above, Bhattacharyya et al.'s⁸³ proposed steps could provide a useful guide for an inquiry into the most effective method for communicating the

body of evidence-based knowledge concerning healthy and effective music-making to young student musicians.

Conclusions

There is growing awareness of the physical and mental health risks associated with long-term engagement in music-making activities, particularly when considering the intensive routines employed by prodigious children and youth. Consequently, those in charge of musicians' training are coming to recognize their role in equipping musicians with the skills to enjoy long and healthy music careers. However, the inclusion of developmentally-appropriate training programs relating to healthy and effective music behaviours for children and youth currently lags behind that available for tertiary-level music students. To address similar issues, many sports have adopted long-term athlete development models to help guide the development of sport-specific and general personal skills in their participants. While the creation of a comparable long-term musician development model might offer similar benefits to the music profession, many questions concerning the content, structure, and delivery of such a model remain. Implementation science offers an option for comprehensively examining these questions. It might be that such lines of inquiry do result in the generation of some form of long-term musician development model, together with accompanying guidelines for its implementation. In addition to specific content, such guidelines could also offer instruction to music teachers and those in charge of structuring musicians' training on how to deliver the content to their students most effectively. Equally, the research might conclude that a long-term musician development model would not be the most appropriate method for imparting the body of evidence-based knowledge to musicians. Either way, as awareness and concern for the health and well-being of musicians at all levels of development continues to grow, continued initiatives to ensure that musicians are equipped

with the skills to cope with the physical and mental demands of the profession will be required from those who train and support them. Implementation science offers one such methodological option for how this investigation could be conducted.

Highlighting the potential value of providing training in healthy and effective music behaviours to young musicians, research within child development has examined the rate of return on investment in early intervention programs. Cunha, Heckman, and Navarro⁸⁴ determined that one dollar invested in early childhood can be worth three times as much for every dollar invested for school-aged education and eight times as much for adult education. While no comparable data within the performing arts currently exists, this suggests that waiting until musicians are at the tertiary level to begin providing them with health and wellbeing training could cost eight times as much as introducing such training to musicians at the beginning of their engagement with music. Given the tight financial constraints within which much of the performing arts sector functions, such a perspective certainly gives reason to reconsider how musicians are trained.

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Table 1. 7-stage Long Term Athlete Development model.

Stage	Age – Early Specialization	Age – Late Specialization	Key objectives
1) Active Start	0-6 years old	0-6 years old	Exploration and development of fundamental movement skills
2) Fundamentals	6-8 females/ 9 males	6-8 females/ 9 males	Overall development of physical capacities, fundamental movement skills, ABC’s (agility, balance, coordination, and speed)
3) Learning to Train	7-11 females/ 12 males	8-11 females/ 12 males	How to train and basic fundamental skills of a specific sport
4) Learn to Compete	9-13 females/ 10-14 males	11-15 females/ 12-16 males	Build ‘engine’ and consolidate sport skills. Introduced to basic technical/tactical skills and ancillary capacities including warm-up and cool-down, stretching, hydration and nutrition, recovery and regeneration, mental preparation, taper and peak, integrated pre-competition routines and post-competition recovery
5) Training to Compete	10-16 females/ 11-17 males	15-21 females/ 16-23 males	Optimizing “engine” and refine sport skills. Learn to perform sport-specific skills under a variety of competitive conditions during training. Special emphasis placed on optimum preparation by modelling training and competition. Fitness programmes, recovery programmes, psychological preparation, and technical development are now individually tailored to a greater degree.
6) Training to Win	13-19 females/ 14-21 males	17+ females/ 18+ males	Maximize “engine”, skills, and performance. All physical, technical, tactical, mental, and ancillary capacities are now fully established and the focus of training has shifted to

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optimisation of performance. Athletes are trained to peak for major competitions.

Training is characterised by high intensity and relatively high volume.

7) Active for Life/ Retirement/ Retraining	Any age	Any age	Ex-athletes move into sport-related careers that may include coaching, officiating, sport administration, small business enterprises, masters competition and the media.
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Appendix A: Survey of existing programs and modes of music training

Institution	Early Childhood	Children	Adolescents
Mount Royal Conservatory, Calgary, Canada	Newborns and toddlers classes - Kodaly - Music and movement	Early Strings Suzuki piano Kodaly, Orff Choirs	Academy program
Royal Conservatory of Music, Toronto, Canada	Smart Start - Orff, Kodaly, Dalcroze	Diploma and Suzuki Programs - Lessons, musicianship and theory, performing	Diploma and Suzuki Programs (see left)
Eastman School of Music	3 introduction to music classes - Music time, Music makers, Clef Club	Beginner String Program Theory in Motion - Orff, Kodaly, Dalcroze	Nothing specified, but probably a Junior Department
Cleveland Institute of Music	Eurhythmics - Music and movement	Suzuki Program	Young Artist Program -“Rigorous course of music study”
Manhattan School of Music		Pre-college Division (5-18 y.o.) - Lessons, theory and ear training, composition, conducting, chamber groups	Pre-college Division (see left)
Julliard School		Pre-college Division Music Advancement Program (8- 14 y.o.) - Lessons, theory and ear training, orchestra, chamber music	Pre-college Division (see left)
Hong Kong Academy		Junior Music Program - Lessons, musicianship, ensembles, performing	Junior Music Program (see left)

Sydney Conservatorium	Con for Kids (3-10 y.o.) - Orff-Schulwerk	Rising Stars Program - Lessons, theory, history, aural skills, sight singing, performing	
Auckland University School of Music		Academy of Music - Not a formal program, a series of 1-day workshops	
Yong Siew Tow, Singapore		Young Artist Program (teenagers) - Lessons and studio classes, academic classes	
Nanyang Academy of Fine Arts, Singapore		Access Course (post-high school; ages 18-19) - Lessons, music appreciation, theory, aural skills, choir, ensembles	
Australian National University	Early Childhood Music (0-6 y.o.) - Music and movement - Creative music making - Early musicianship	A range of music engagement programs	Music for Colleges (Yrs 11 & 12; ages 16-18) - Lessons, musicology, ensembles, performing
Royal College of Music, London		Junior Department (8-18 y.o.) - Lessons, chamber, orchestra, musicianship, Alexander Technique, aural skills, performing	Junior Department
