

PIANO KEYBOARDS – ONE SIZE DOES NOT FIT ALL!

PIANISTIC HEALTH FOR THE NEXT GENERATION

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1. INTRODUCTION

‘In a world of 7/8 stringed instruments, various-sized tennis rackets, baseball bats, rings, clothing, shoes, hats, prescription glasses, golf clubs and so on, surely we realise that one size does not fit all.’ (Dr Carol Leone, Chair of Keyboard Studies, Meadows School of the Arts, Southern Methodist University, Dallas, Texas, USA (2003).)

‘Unfortunately, with the piano keyboard, a ‘one size fits all’ mentality has prevailed. Players having small-sized hands have historically been dedicated amateurs.’ (Dr Brenda Wristen, Associate Professor Piano Pedagogy and Keyboard Skills, University of Nebraska-Lincoln, Nebraska, USA, et. al. (2006).)

The width of piano keys (and hence, keyboard size) became standardised in the late 1800s. The idea that the current keyboard size is somehow ‘sacred’, that it suits all pianists, or cannot be varied for musical or technological reasons, has rarely been questioned. However, the ‘one size fits all’ approach is increasingly being challenged, prompted by the availability of reduced-size keyboards in North America through a small manufacturer in Pennsylvania, the growing evidence from research relating to pain and injury, and the personal experiences of pianists and teachers who use these keyboards.

The reality is that human hands vary enormously in size – children compared with adults, males compared with females, as well as across ethnic groups. It appears that the current piano keyboard was designed to suit Caucasian male virtuosos late in the 19th century.

There is now very strong evidence that pianists with small hands are more likely to suffer pain and injury than those with larger hands. Small-handed pianists (ranging up to females with ‘average’ size hands for their gender) report how much easier and more enjoyable piano playing

is on a smaller keyboard, the dramatic reduction in time spent on overcoming technical difficulties, and the greater choice of repertoire available. This leads one to conclude that a large proportion of pianists, particularly women and children, are unable to reach their full potential, both musically and technically, with the conventional keyboard.

This paper builds on a paper presented at the 2009 APPCA conference (Boyle & Boyle, 2009), and is accompanied by demonstrations using conventional and 7/8 keyboards to illustrate many of the points discussed. Since that conference, both Rhonda Boyle (2010a, 2010b) and Erica Booker (2010a, 2010b) have had papers published in the UK and Australia on the subject of hand size and the piano keyboard.

2. THE EVIDENCE

The case for a choice in piano keyboard size, and why the current size is skewed heavily towards larger-handed (mostly male) pianists, is illustrated conceptually in Figure 1. We will now discuss the evidence for these claims in some detail, using examples from the well-known piano repertoire to illustrate key points.

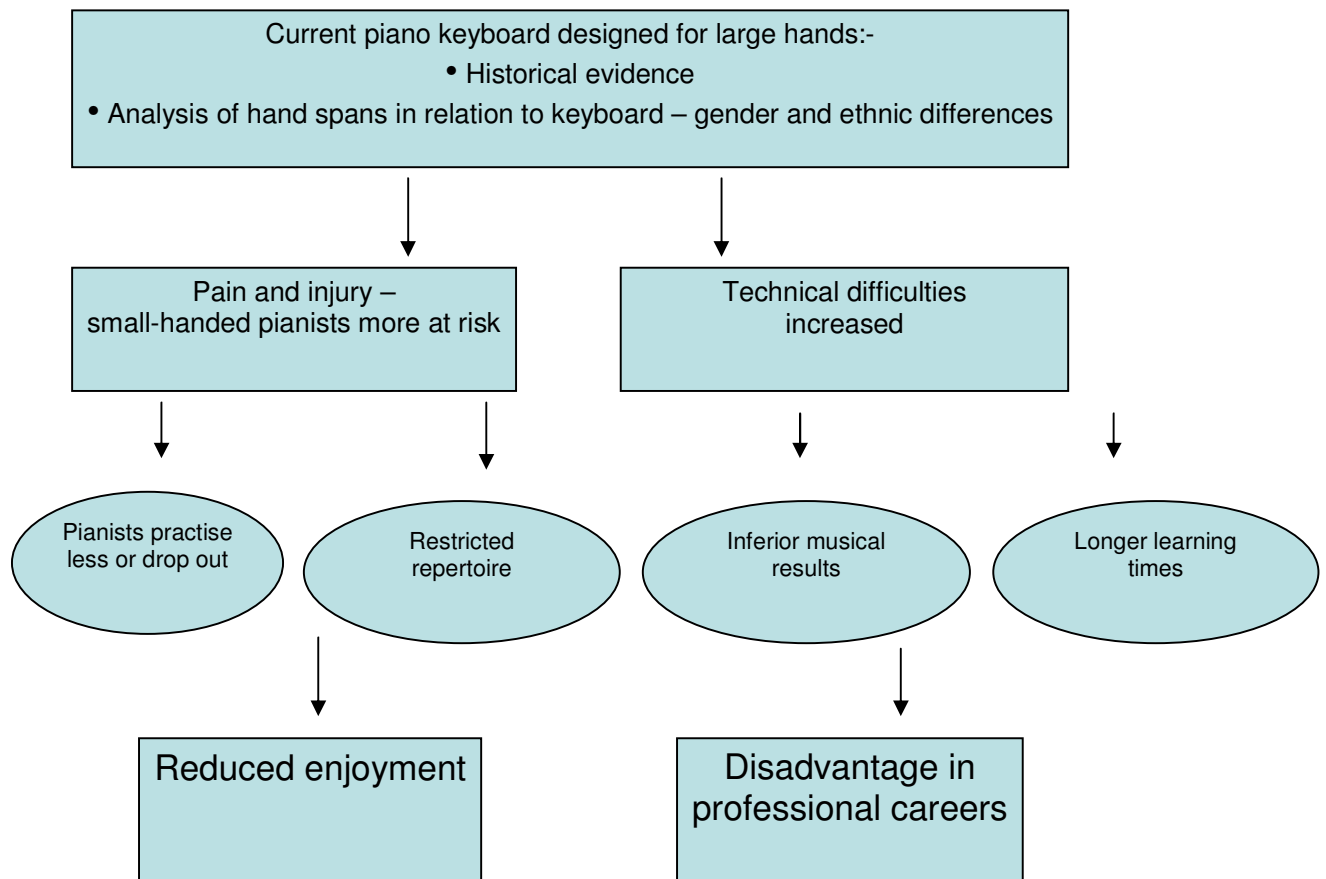


Figure 1: The impacts of the ‘one size fits all’ approach to the piano keyboard

2.1 ANALYSIS OF PIANO KEYBOARD SIZE IN RELATION TO HAND SPANS

2.1.1 Historical development of the piano keyboard

Piano keyboards have not always been the size they are today; between 1784 and 1876, they were smaller. Sakai (2008) has documented the variations in keyboard span of various keyboard instruments dating back to 1559. These range from 180 mm for the clavichord to 188 mm (measured across eight keys) for the modern piano keyboard. A substantial amount of well-known piano repertoire was written between 1750 and 1850 at a time when the keyboard was smaller (with both shorter and narrower keys) and repertoire rarely contained intervals larger than an octave.

The current piano keyboard size became fixed around 1880. Donison (2000) and other authors state that the current keyboard size was based on the needs of European composers (who were often leading performers) at that time. This appears to be a plausible explanation for how the size was determined, considering prevailing social attitudes and the close relationship between composers/virtuosos and piano manufacturers. Although piano playing was seen as a highly desirable accomplishment for ladies of upper and middle classes (like learning to cook and sew), and many worked very hard to develop their skills with the help of their teachers, they were destined to be amateurs. Piano playing by women was often an integral part of social activity, including the courtship ritual. There was a clear distinction between amateur players who played within the home and the male virtuosos who performed in public venues.

During the 19th century, separate piano competitions were held for men and women at the Paris Conservatoire, with the expectation that female competitors would be dignified, feminine and graceful. Karl Czerny and others warned women that they were not 'ready' to play certain repertoire. It is certainly clear that it was not appreciated for females to play as well as males, and direct comparisons were strongly discouraged (Parakilas et.al., 1999). Becoming a public performer was not seen as appropriate for women who were mainly found in lower status jobs in conservatories or became private teachers.

During the late 1800s, there was a strong relationship between famous performers and composers of the day (Parakilas et.al., 1999). Manufacturers had their 'house' pianists (e.g. Liszt with Erard, Kalkbrenner with Pleyel) and they organised tours for these virtuosos in order to market their products. They even built and managed concert halls. US manufacturers also competed with the Europeans by organising tours; for example, Anton Rubenstein and Paderewski both toured the USA for Steinway in the late 1800s. During this century, however, a Czech company designed and marketed a smaller keyboard for 'ladies'.

While the piano keyboard became larger with a heavier action to suit the larger concert halls built during this period, it is clear that the keyboard size that became the 'standard' from around 1880 also took into account the needs of the dominant male composers and virtuosos of the time. As Christopher Donison (1998, p.42) states:

‘The one-size-fits-all approach has prevailed in the piano-keyboard world for nearly 100 years. And, like other one-size-fits-all systems, the largest was fitted, not the average...Manufacturers were not about to make an instrument that would cause some European Caucasian male who sat before it to say. “These keys are too small.” What developed was a standard keyboard too small for nobody, but too large for many.’

Until about a decade ago, there were no attempts by manufacturers to vary piano keyboard size, although it is well known that the great pianist Josef Hofmann used a reduced-size keyboard (essentially a 7/8) designed for him by Steinway & Sons in the early 20th century. The development of the DS™ standard keyboard by David Steinbuhler and Chris Donison in North America is described in the paper presented to APPCA in 2009 (Boyle & Boyle). The Steinbuhler Company retrofits grand pianos with 7/8 or 15/16 action/keyboards, requiring individual measurements of each piano. Steinbuhler also provides these keyboards for new Walter upright pianos.

2.1.2 Hand span data – gender and ethnic differences

Hand size varies greatly among the human population. Yoshimura and Chesky (2009) report that the difference between the smallest and largest hand spans of nearly 400 piano students at the University of North Texas is 4 inches (11 cm) – close to the width of five piano keys!

Previous published data on pianists’ hand spans, showing gender differences, were described in the paper presented to the last APPCA conference (Boyle & Boyle, 2009). Data collected by David Steinbuhler (2004) at the US Music Teachers’ National Association (MTNA) conference and by Wagner (1988) in Germany are very similar in terms of summary statistical measures, based on the reasonable assumption that hand span data from a sufficiently large sample would approximate a normal distribution. Although these datasets were not derived from scientifically-based random samples, important findings were that:

- approximately 75% of adult females have hand spans smaller than the 75% of adult males with the largest spans, and

- comparing the arithmetic means and medians, the average hand span of an adult male is approximately one inch (2.5 cm) greater than that of an adult female (representing almost the width of one key on the conventional keyboard).

It is interesting to consider whether the distribution of pianists' hands sizes reflects the human population as a whole, and also the influence of ethnic origin. Much of the detailed published anthropometrical data is not based on random samples of the adult population, but on measurements from armed forces personnel in the USA: e.g. Garrett (1971), Greiner (1991), Donelson and Gordon (1996) or from industrial workers: e.g. Nag, Nag & Desai (2001), Saengchaiya & Bunternghit (2004). In most cases, hand spans have not been measured. In relation to other hand size measures, differences between the means for males and females generally range between 10% and 20%, depending on the characteristic measured.

Wagner (1988, p.117) notes that, based on studies prior to that time, musicians tend to have greater finger spans than non-musicians. Looking at a range of recent data on hand lengths and widths, there is no obvious difference between pianists and general adult populations in terms of hand length, though pianists' hands tend to be narrower. (A detailed statistical analysis has not been done.)

The majority of pianists (95% of males and 86.5% of females) measured by Wagner (1988) were of Caucasian origin. The ethnic background of MTNA pianists (Steinbuhler, 2004) was not recorded, but is known to be mixed. It is commonly stated that people of Asian ethnicity have smaller hands than those of Caucasian origin (e.g. Sakai, 1992, 2008, Furuya et al., 2006). Published comparative hand anthropometry data, e.g. Saengchaiya & Bunternghit (2004), Nag, Nag & Desai (2003) and Mandahawi et al (2008), clearly show that people of Asian descent have smaller hands than Caucasians. One such study (Nag et.al., 2003) does include data for hand span; the mean active 1-5 span¹ of the sample of Indian women was only 6.8 inches (173 mm) and their active 2-5 span² was 5.4 inches (138 mm).

¹ Distance from tip of thumb to tip of fifth finger when stretched to maximum

² Distance from tip of index finger to tip of fifth finger when stretched to a maximum

2.1.3 Hand span in relation to the piano keyboard

It is useful to relate hand span to the capacity to stretch a specified interval on the conventional keyboard. The paper presented to APPCA in 2009 (Boyle & Boyle) described the results of measurements of a number of pianists in order to calibrate 1-5 active hand span³ against ability to play different intervals – either comfortably (ability to slide thumb and fifth finger in towards the black keys) or just reaching (‘on the edge’ of the white keys). The original data is available at *Hand span versus maximum interval measurements* (2009): <http://www.cicadabay.com/pianos>.

Relating these findings to the statistical summary measures shown above, it appears that a significant minority of females (around 20%) cannot play an octave comfortably on the conventional keyboard, and a significant majority (80%) cannot play a ninth comfortably, nor a tenth even ‘on the edge’. On the other hand, it seems that around 80% of males can play a ninth comfortably and a tenth, at least ‘on the edge’, using the conventional keyboard. (See Figure 2.)

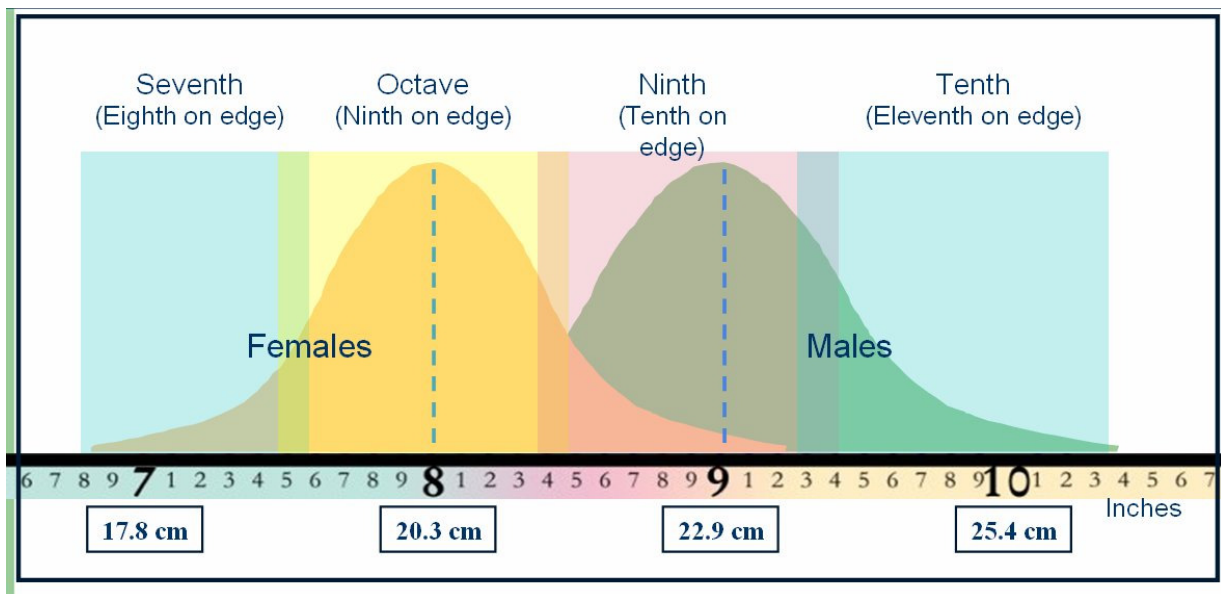


Figure 2: Hand spans and the piano keyboard: zones for comfortable playing

³ Distance from tip of thumb to tip of fifth finger when stretched to a maximum.

By transferring to a 7/8 keyboard, one extra white note is added to the maximum interval that can be played by any individual, i.e. in effect, their hand span becomes one inch larger, compared with playing the conventional keyboard. For example, when playing the 7/8, someone with a 7-inch span becomes equivalent to a person with an 8-inch span on the conventional keyboard. The average 8-inch female hand span on the 7/8 is approximately equivalent to the average 9-inch male hand span on the conventional keyboard. This means that the female hand is approximately in the same proportion to the 7/8 keyboard as the male hand is to the conventional keyboard.

Dr Carol Leone (2003, p.27) has recognized this key fact: *‘The female hand is, on average, 15% smaller than the male hand. This statistic is very interesting when one realises that that translates to female hands being generally 7/8 the size of male hands....The conventional keyboard is designed to fit the average large hand. When playing the 7/8 keyboard, it is clear that I am replicating [my husband’s] experience on the conventional keyboard.’*

It is accepted that humans today are somewhat larger than people of a century ago. However, this trend should be balanced against the demands of 20th century repertoire that often requires larger hand spans, and the greater ethnic diversity of pianists, especially the growing numbers from Asia. A consideration of optimum piano keyboard size (or sizes) should be based on the measurements of the current generation of pianists: men, women and children across all ethnic groups.

2.2 PAIN AND INJURY – RISKS TO SMALL-HANDED PIANISTS

The evidence supporting a need for reduced-size keyboards, from a pianistic health perspective, is growing rapidly, drawn from three major types of research:

1. Epidemiological studies linking hand size to piano-related pain and injury
2. Principles from the sciences of ergonomics and biodynamics
3. Comparative studies involving the use of reduced-size and conventional keyboards.

This literature is reviewed in the paper presented to the last APPCA conference (Boyle & Boyle, 2009). Since then, further published research has strengthened the conclusion that small-handed pianists are more likely to suffer pain or injury. Evidence points to the need for excessive

stretching of the hand, with pain and injury linked to the playing of fast octave and chordal passages in particular. Sakai's most recent research (2010) indicates that thumb hyper-abduction and extension is likely to cause lateral epicondylitis, forearm extensor pain and de Quervain's disease in small-handed pianists.

Yoshimura and Chesky (2009) from the University of North Texas, compared pain and tension among university piano students using the conventional and 15/16 keyboards. Levels of pain and tension were found to be significantly higher among students with smaller hands. The results also indicated a significant reduction in pain when using the 15/16 compared with the conventional keyboard. This difference was statistically significant for the smaller-handed group. The authors also analysed hand postures visually and noted the obvious greater comfort for larger-handed pianists and excessive stretching for those with smaller hands. The results are consistent with widely accepted principles of ergonomics.

Anecdotal evidence is also available from many of the North American pianists who now use reduced-size keyboards, many of whom previously suffered pain or injury. In virtually all cases reported in the survey of North American pianists (Boyle & Boyle, 2009), previous problems had disappeared since they made the change. This means longer practice times become feasible. For example:

(a) From Amy Keffabers in Pennsylvania:

Description of pain and injury: *'Hand and arm cramps. Hands went numb too. Shortened my practice time and enjoyment.'*

Change since using 7/8 keyboard: *'Haven't had any since, and when I have the time, I am able to practice extended hours.'*

Overall benefits: *'I like the comfort of playing, feels less frustrating. I never knew this was a possibility so it seems like a miracle to me. After 30 years of playing, to have this opportunity is heavenly. And now when circumstances call for my over-2 hours of practice, I don't dread the pain. My confidence has grown as a result.'*

(b) From Jen McCabe in Ontario:

Description of pain and injury: *'Tension in arms and hands, numbness. I could not play for longer than 10 minutes and did not play for 2 years because of it.'*

Change since using 7/8 keyboard: *'I can play for much longer and continue to play every day. I don't get frustrated from the pain and from being limited in my playing.'*

2.3 INCREASED TECHNICAL DIFFICULTIES

'I thus began the great discovery of what it feels like to play the piano with larger hands. It was like an epiphany. All the touches and techniques in piano studies – and I stress ALL of them – were made easier by a factor of a hundred.' (Christopher Donison, Executive Artistic Director, *Music by the Sea*, and co-inventor of DS™ keyboards, British Columbia, Canada, 1998, p. 42.)

Comments by pianists using reduced-size keyboards come from various sources including published papers by Dr Carol Leone (Head of Keyboard at Southern Methodist University, Texas), Christopher Donison (Canadian pianist), results of a survey of 14 pianists (all with hand spans less than 8 inches, or 20 cm) in North America (Boyle & Boyle, 2009), and the current authors. Pianists responding to the 2009 survey reported 'dramatic' or 'considerable' improvement with many of the 22 pianistic skills (both technical and musical) listed. On the more 'technical' side, these included: fast passages of octaves or large chords, leaps, broken octaves, broken chords/arpeggios, accuracy, and overall feeling of security.

Greater technical ease brings with it the possibility of increased speed as well as the ability to focus more on musical aspects. A fundamental reason for the improved technical ease relates to figures being more 'under the hand', necessitating far less hand movement and uncomfortable stretching. Being 'under the hand' means much more than the most obvious impact, being able to reach chords that were previously not possible, but also:-

- the hand being more compact, is more relaxed, with fingers closer to the keys (particularly noticeable when playing octaves and large chords)
- wrists not having to strain in a high position in order to reach a wide span
- reduced need for mini leaps in order to maintain good technique
- shorter distances to travel for leaps
- reduction in hand position changes
- reduction in non-standard, awkward fingering (marked fingering suddenly makes sense)

- rolled chords being reduced in number and difficulty
- leaps and wide spread arpeggio-type figures feeling much more secure.

'The technical approach on the smaller keyboard involves smaller, more refined movements and less use of throwing, pivoting, rotating and generally 'flying about'. (Dr. Carol Leone, Chair of Keyboard Studies, Meadows School of the Arts, Southern Methodist University, Dallas, Texas, USA, 2003.)

As stated by Christopher Donison (in an email to Rhonda Boyle, 31/12/2006), the experience of playing the smaller keyboard is 'a lot more profound than merely stretching a distance between any two digits.'

The feeling of changing to the smaller keyboard can be compared with a skier's experience of changing to the shorter Alpine skis which became available during the 1990s. New technology and design meant that these skis became feasible without the previous disadvantages associated with shorter skis, such as instability. Similar to the experience on the ski slope, many previous technical difficulties for pianists disappear or are much reduced after changing to a smaller keyboard, with the result that less time is spent trying to overcome, or mask technical problems and more time can be spent on musical interpretation.

Even males with spans typical or even larger than average for their gender find certain repertoire easier. Victorian professional pianist and teacher, Glenn Riddle, remarked how much easier certain Chopin Etudes (opus 10 no. 1, and opus 10 no. 11) became on the 7/8 keyboard. For these pianists, a smaller keyboard effectively takes them into the realm of males with extra-large hands, such as Richter, Van Cliburn and Howard. For larger-handed performers, the choice of optimum keyboard size is likely to be a trade-off between having a greater span and ability to fit their fingers between the black notes.

2.4 RESTRICTED REPERTOIRE

All respondents to the survey of North American pianists (Boyle & Boyle, 2009) reported improvements with existing repertoire and most had added new repertoire since beginning to play the reduced-size keyboard. Romantic works were frequently mentioned as being tackled for the first time or becoming much easier, including Chopin, Liszt and Rachmaninoff Etudes, other

Chopin repertoire such as the opus 53 Polonaise and Ballades, and works by Brahms, Debussy and Ravel. From Linda Gould (Canadian pianist and the first purchaser of a DS™ 7/8 keyboard):

'I couldn't ever get a Chopin Etude to performance level. Now I can!'

Others nominated any repertoire with large chords or octaves requiring a fast tempo or legato playing, as well as Bach (where inner voices needed to be held), Beethoven, and some 20th century composers. One mentioned improved security with Mozart.

The authors have also been able to tackle substantial new repertoire. Rhonda Boyle has found that a wide range of previously unplayable repertoire is now within the 'playable' category. In some cases, this new repertoire has been found to be very difficult due to many figures still not being 'under the hand', even on a 7/8 keyboard. This is because Rhonda's active 1-5 hand span is at the lower end of the hand span distribution for females (7 inches), meaning that the 7/8 effectively brings her up to the 'female average' of 8 inches, resulting in an octave being reasonably comfortable, a ninth just playable 'on the edge' but a 10th not possible. In addition, her active 2-5 span is particularly restricted, which is still a significant issue in many pieces. For repertoire that is primarily octave-based however, the 7/8 means that previously unplayable works are, for her, now quite manageable.

There are many examples in the popular piano repertoire when it can be argued that a hand span that can accommodate a 10th is required to achieve a good result. This is not restricted to situations where one needs to actually play a 10th without rolling, but is exemplified by the difficulties of achieving a secure and good musical result with wide-spread figures such as large rolled chords in one hand combined with fast passage work or arpeggios in the other, fast double-sixths, and the ability to shape melody lines while the thumb is holding down lower notes. Examples in Chopin's music can be found in the Fantasie in F minor (opus 49), and in a number of nocturnes, etudes and preludes.

Although Figure 2 indicates that playing an octave 'comfortably' requires a hand span of about 7.6 inches, this refers to just being able to slide the hand in, away from the edge of the keys. This span does NOT allow the pianist to slide their hand in towards the back of the keyboard, arching the hand comfortably over the black keys in between. This point is only reached with hand spans of about 8.5 inches and above – about the same point as where a 10th becomes playable 'on the edge'. Hence, being able to play fast passages containing octaves without moving the hand in and

out from the front to the back of the keyboard, clearly an advantage in many situations, is a further reason for suggesting that a hand span that accommodates a 10th is desirable.

The ‘average’ female pianist with an 8-inch span, who can play a 10th for the first time on a 7/8 keyboard (and is therefore on a level playing field with the ‘average’ male with a 9-inch span on the conventional keyboard), is able to tackle repertoire normally the preserve of male pianists, such as Rachmaninoff and other Russian composers, Ravel, and advanced Chopin or Liszt works requiring larger spans to play effectively.

2.5 INFERIOR MUSICAL RESULTS

Musical differences reported by pianists (Boyle & Boyle, 2009; Leone, 2003; Donison, 2000) using reduced-size keyboards include:-

- improved legato and musical line
- less reliance on the pedal to mask mini leaps and notes not held
- ability to perform legato octaves
- increased power due to the hand being more compact
- improved voicing of chords and balance.

As already mentioned, improved technical ease allows the ability to spend more time on musical aspects rather than just focusing on hitting the right notes.

The survey of North American pianists (Boyle & Boyle, 2009) found that pianists with hands in the 7.5-inch to 8-inch range reported benefits just as significant as those with the smallest hands (less than 7.5 inches). This supports the conclusion that even female pianists with ‘average’ size spans for their gender tend to prefer smaller keyboards.

Actual hand size and shape, however, would most likely influence pianists’ reactions. For a pianist with extremely small hands, the expanded repertoire suddenly available and ability to play octaves and large chords far more comfortably are among the most dramatic changes. For a pianist with a hand span closer to the average for females, as in the case of Carol Leone, for example, (Leone, 2003, p 28) the changes for much existing repertoire may be more subtle, such as the improved legato playing, musical line and phrasing. Many of these more subtle differences

are what differentiate a great pianist from one who is simply competent, in other words, those who win major competitions and go on to successful performing careers from those who do not.

As well as the extra time needed to conquer technically difficult passages, the authors' experience leads them to believe that when focusing on extreme technical problems, it is simply not possible to think about the musical issues to the extent required to achieve excellence, no matter how much practice has been done. When playing a piece on the smaller keyboard that was previously learnt on the conventional keyboard, it immediately becomes obvious how much physical and mental effort had been invested to just 'get the notes' in passages that were not 'under the hand' on the conventional keyboard. This difference is magnified when **both** hands are dealing with difficult tasks (e.g. fast octaves in one hand and wide spread arpeggio-type figures in the other, often encountered in Chopin). On the smaller keyboard, suddenly one no longer has to focus on just reaching the octaves, but there is the ability to relax the hands and think about shaping the musical line being played by both hands (e.g. Chopin Scherzo No. 2 – middle section and finale). It follows that, in such situations, a small-handed pianist cannot focus on the musical result to the same extent as could a pianist of equivalent technical and musical ability, but with larger hands. Therefore, *ceteris paribus*⁴, a pianist with small hands is at a disadvantage when performing a significant amount of advanced piano repertoire. (*'Ceteris paribus'* is familiar to scientists from many disciplines and is a useful way of thinking about complex situations where a number of variables affect the end result.)

Based on their experience with the 7/8 keyboard, the authors (both of whom have hand spans of less than 8 inches, or 20 cm,) believe that a pianist needs a hand span that can reach a 10th (requiring a span of at least 8.5 inches, or 21.5 cm) to achieve excellence – both technical and musical – across a wide range of repertoire. A hand span around the 8-inch mark means, for example, that octaves still feel rather stretched (particularly in long passages such as in Chopin's Butterfly Etude or Heroic Polonaise), which limits speed and technical ease, legato octaves are not always possible, passages containing octaves still require significant inward and outward movement when moving between black and white. Also, the shaping of phrases (e.g. Brahms Intermezzi) where the thumb is holding down lower notes, and effectively voicing thick chords (e.g. Chopin Prelude No. 17 in A flat), may be difficult to achieve.

⁴ *Ceteris paribus* means 'everything else being equal'.

2.6 LONGER LEARNING TIMES

'I realize now, looking back' that most of the time I spent practicing was used trying to overcome difficulties because of my hand size....If you spend 90% of the time trying to overcome limitations imposed by hand size, then you are truly disadvantaged'. (Christopher Donison, Executive Artistic Director, Music by the Sea, and co-inventor of DS™ keyboards, British Columbia, Canada, 1998, p. 43.)

The greater the degree of technical difficulty facing a pianist, the greater the amount of practice required. To maintain good technique and minimise strain, small-handed pianists need to leap across the keyboard much more, requiring more practice just for the sake of accuracy.

All pianists surveyed in 2009 (Boyle & Boyle) noted the greatly reduced learning time after transferring to the smaller keyboard. The authors' experience confirms this conclusion.

2.7 THE ULTIMATE IMPACTS

2.7.1 Reduced enjoyment and health

Any pianist using a smaller keyboard would undoubtedly agree that the increased technical ease, reduced stretching and straining, and reduced need to focus on technical issues and ability to think more about the music, reduced anxiety about the possibility of 'coming to grief', and the expanded repertoire available, all contribute to a dramatic increase in enjoyment. Greater comfort and technical facility, plus reduced risk of mistakes or injury are also closely linked with improved quality of a performance, leading to greater ease and confidence.

Comments from the survey of North American pianists (Boyle & Boyle, 2009) included:

'Everything improved for me; it is so much fun to practice.'

'I never knew this was a possibility so it seems like a miracle to me. After over 30 years of playing, to have this opportunity is heavenly.'

'For me, the most enjoyable aspect of playing on the reduced-size keyboard is how it felt: finally I was playing on a piano that was the right size for me. It was as if I had been trying to walk around in shoes that were a size too big and then at last I got a pair that was the right size. Everything, from runs and leaps to sound and memorisation, was easier. Also, I had to spend less

time working on the technical issues, which allowed me to focus more on the musical issues. My senior recital that I played on the reduced-size keyboard...was by far the strongest piano performance I ever gave.'

Although the majority of pianists do not become professional concert pianists for a variety of reasons, why should so many be unnecessarily excluded from playing certain repertoire solely on the basis of hand size? As Erica Booker says:

'In my youth, I wanted to play a Rach concerto and my teacher said to me: 'Ingrid Haebler wouldn't dare!' implying, to my angst, that I was destined to be one of the Baroque/Classical pianists who never touched a Romantic work!'

2.7.2 Career disadvantage

While small-handed pianists can choose repertoire to suit their hand size, successful concert pianists (including those who perform in ensembles) are normally expected to play a wide range of repertoire. Audiences tend to enjoy the spectacular late Romantic works. A Bach or Mozart specialist is likely to face added difficulty in attracting an audience and many pianists may not want to specialise so narrowly in any case – the Baroque/early Classical repertoire may not suit their musical style.

It has been argued above that a pianist wanting to perform at a high level would need to have a hand span that can reach a 10th to achieve excellence with a wide range of repertoire. The impact of the 7/8 keyboard is that the 'average' female is brought into the realm of the 'average' male in terms of hand span – opening up opportunities for a much larger proportion of women to perform works by Russian composers, for example.

At elite levels of piano playing, very subtle things will distinguish winners from everyone else – just as in many sports. The more technical barriers a pianist has to overcome, the greater the disadvantage in relation to others with the same ability but without those barriers, of which hand size is clearly one. Other physical factors that could negatively affect a performance, such as stool height, have long been recognised by pianists and dealt with by providing choice.

Piano performance can be compared with those sports that require a blend of artistic and technical skills (such as many winter sports). The quality of equipment and clothing and their suitability for the specific needs of the performer can make a difference at the highest levels of

competition. Any skier in an international competition would be disadvantaged if his/her skis were too short or too long for the particular event. For elite pianists, competition for performing careers is intense and a high level of technical skill and musicality is taken for granted. Pianists who are able to perform on an instrument most suited to their hand size are likely to perform the advanced repertoire better and with greater security.

For the bulk of adults who have learnt to play the piano at some stage but are not in the music profession, and may play only occasionally for 'sing-alongs' or to tinker with old exam pieces, the size of the piano keyboard probably does not matter greatly. As described in the next section, adapting or swapping between different keyboards is remarkably easy. Adults who occasionally play relatively easy repertoire can be compared with the bulk of recreational skiers who do not venture beyond relatively easy groomed slopes – for them, slight differences in ski length or quality may not have an obvious impact on their style and technique.

Christopher Donison (1998) has commented on the relatively small proportion of female piano competition winners, given that they generally significantly outnumber male students in universities. Reviewing the prize-winners in several international piano competitions over the last half century, men do indeed outnumber women among the prize-winners, in all except two of these competitions. For the Van Cliburn, Leeds, Sydney, Beethoven and Liszt competitions, the percentage of female prize-winners, over all competition years together, ranges between 20% and 25% depending on the competition. In the International Chopin competition, women have been more successful, making up 40% of prize-winners. However, looking at first prize winners in each of these competitions, the proportion of women shrinks further in most cases. There has been only one female winner of the Leeds competition, two in each of the Van Cliburn and Sydney competitions, two in Chopin and three in Beethoven. No woman has ever won the Liszt competition. On the other hand, in the International Bach competition (only held four times), and the International Mozart Competition (considering age categories of 17 and above), women have significantly outnumbered men among the prize winners, suggesting that when playing Bach or Mozart, men and women may be much more on a level playing field. Table 1 summarises these results.

Considering ethnic background of all 18 female first prize winners, one third came from Russia. Three of the eight female winners of the Mozart and Bach competitions were from Asia, while

the only Asian woman to win any of the other competitions was a Japanese pianist who won the 1969 Beethoven competition.

Table 1: International Piano Competition Winners

Competition	Total number of prize winners*			Number of first prize winners		
	Males	Females	Females as % of total	Males	Females	Females as % of total
Van Cliburn	65	17	20%	11	2	15%
Leeds	65	22	25%	15	1	6%
Sydney	73	18	20%	7	2	22%
Liszt	29	9	25%	9	0	0%
Chopin (since 1955)	49	33	40%	8	2	20%
Beethoven	27	9	25%	9	3	25%
Mozart	11	25	69%	3	6	67%
Bach	3	12	80%	1	2	67%

*excluding special prizes

The national US music competitions run by the MTNA (Music Teachers National Association) are held annually and include four age categories: Junior (11-14 years), Senior (15-18 years) and Young Artist (19-26 years). Reviewing results since 1963 (refer Table 2), females outnumber males among first prize winners in the junior category, but males outnumber females in the senior category and even more decisively (almost double) in the ‘young artist’ category. Interestingly, when looking at the results of the MTNA strings competition, there is no similar drop-off of female prize winners with age – females dominate in all age groups, though less so in the ‘young artist’ category.

Table 2: US MTNA competitions – number of first prize winners

	PIANO		STRINGS	
	Males	Females	Males	Females
Junior (11-14)	21	27	11	16
Senior (15-18)	27	19	15	30
Young Artist (19-26)	28	15	17	21

These observations lend support to the contention that their smaller hand size prevents many women from achieving their full potential in piano playing at elite levels – particularly in the performance of Romantic and 20th century repertoire. In those elite competitions where a wide range of repertoire must be presented, plus those focusing on specific Romantic composers, the proportion of male to female prize winners (approximately three or four to one), is similar to the proportion of males to females who have hand spans large enough to accommodate a 10th.

3. THE BARRIERS

Given the evidence presented, one may wonder why pianists have not already demanded change, forcing piano manufacturers to respond. A number of writers have commented on this (Donison, 1998, Yoshimura & Chesky, 2009), mentioning various prevailing myths, lack of alternatives that allow pianists to experience the difference for themselves, and the ‘piano culture’.

3.1 NEGATIVE PERCEPTIONS AND MYTHS

3.1.1 Assumptions about adjusting and swapping between keyboards

Comments about the initial adjustment and swapping between keyboards from North American pianists, such as Carol Leone (2003) and those who took part in the survey of pianists (Boyle & Boyle, 2009) negate common preconceived ideas about such difficulties:

'Our expectation was that it might take days or weeks to adjust to this keyboard. In fact, we found that it generally takes a pianist less than an hour.'

'Those who regularly play both keyboard sizes, as I do, are familiar with both, much as one might be if driving two family cars. Organists and harpsichordists regularly deal with this phenomenon without problems, Violinists who also play the viola experience the same type of dual ability.' (Dr. Carol Leone, Chair of Keyboard Studies, Meadows School of the Arts, Southern Methodist University, Dallas, Texas, USA, 2003.)

This authors' experience is consistent with these claims. As stated by Rhonda Boyle (2009):

'My first attempt at playing the new keyboard resulted in over-shooting octaves, but this tendency was much reduced after 30 minutes or so. Within an hour, I felt reasonably comfortable and was able to play existing repertoire with no great difficulty. The narrower black keys were not an issue. With some repertoire, I am now able to play previously omitted notes or use more appropriate fingering. Becoming secure with such changes requires just a few practice sessions, as is normally the case when making these sorts of changes.'

The authors have also observed other pianists trying a 7/8 keyboard for the first time. Even male pianists with large hands appear able to adapt just as quickly as small-handed females. Erica Booker has piano students aged between four and 40; she has found that they also adapt quickly regardless of age, with the most talented adjusting immediately. As stated by Carol Leone, the dual ability is rather like driving two different family cars. Many of us are used to swapping between automatic and manual cars, or driving on the right hand side of the road when going to other countries. Another example is for skiers who use both Alpine and Nordic skis.

3.1.2 Myths about piano technique

Common myths one hears include: 'hand size does not matter, technique can overcome everything', and playing keyboards of a different size 'will ruin one's technique'. Such myths may have been passed down through generations of pianists, without questioning whether there is evidence to support such claims. There is now overwhelming evidence – from an analysis of hand span in relation to piano repertoire, from performing arts medicine research, from piano competition results at elite levels, and from the direct experience of pianists who have experienced alternatives – that these myths do not stand up to scrutiny.

There is also a tendency for some to say that certain pianists with small hands have achieved success (Alicia de Larrocha is often quoted – who incidentally was able to reach a 10th). One cannot draw conclusions from isolated examples; although there may be exceptional small-handed individuals who have achieved more than would otherwise be expected, their repertoire is almost certainly limited (meaning they are never likely to produce a definitive recording of the complete Chopin or Liszt etudes, nor the Beethoven sonatas) and they would most likely achieve even greater heights with a keyboard more suited to their needs. Once again, *ceteris paribus* is relevant.

Another unfortunate attitude relates to the use of a smaller keyboard as ‘cheating’, as discussed by Yoshimura and Chesky (2009):

‘Another major concern regarding the culture is that pianists genetically fortunate to have been born with large physical traits might label the use of an ergonomically modified keyboard as ‘cheating’. This perspective has been observed and should be considered irresponsible and unsympathetic. Perhaps representing the pinnacle of such perspectives, some small-handed pianists are considered ‘less talented’ because they struggle with a repertoire that requires playing larger chords or because they are no longer able to play due to pain...’ (Dr Eri Yoshimura & Dr Kris Chesky, Texas Center for Music & Medicine, University of North Texas, Denton, Texas, USA, 2009, p 11.)

3.1.3 Lack of opportunities for pianists to experiment with alternatives

An obvious reason for the lack of demand for change relates to the fact that, until very recently, only one size of keyboard has been available over the life-times of everyone alive today. And the numbers of pianists who have played smaller keyboards is still quite small and almost entirely restricted to North America. As Chris Donison (1998, 2000) has said, as a small-handed pianist, he simply did not realise how much easier just about everything is on a smaller keyboard. In addition, he makes the important observation that the larger-handed players never experienced the same problems as small-handed players because their hands were big enough by the time they were playing advanced repertoire, and the smaller-handed players never had the chance to experience the feeling of having larger hands.

3.2 THE ‘CATCH 22’ PROBLEM

A major disincentive for pianists to acquire a reduced-size keyboard at this stage is the lack of availability elsewhere – not just at friends’ houses, but in schools, universities and private teaching studios. There is also the assumption that exams have to be taken on the conventional keyboard, and piano competitions do not, as yet, provide a choice. Early adopters of smaller keyboards, like the authors, must also have a conventional keyboard in their homes if they intend to play in other locations. (This may simply be the original keyboard purchased with a grand piano, however swapping keyboards, while quite straightforward, is not something many people would want to do every day.)

4. CONCLUSIONS

This paper has argued the case for a choice in piano keyboard size, based on the historical evidence that the current keyboard was designed to suit the average large (European male) hand over a century ago, and that those with smaller hands (predominantly women and children) are disadvantaged as a result.

The conventional keyboard relates to the male hand as a 7/8 does to the female hand, hence its availability would essentially ‘level the playing field’. If piano manufacturers were considering the optimum keyboard size today to suit the maximum number and a ‘one size fits all’ approach continued, then they would most likely come up with a standard similar to the 15/16 keyboard. Piano keyboard size has changed over time and there is no logical reason why it cannot change again, nor should that only one size be provided. Piano playing is not a competition to see who can play the largest chords/biggest intervals the fastest (if it were, then males and females would have to be assessed separately, as in most sports). The aim of playing the piano is to produce music for the enjoyment of the performer and for anyone listening.

The fact that small-handed pianists find playing a smaller keyboard much easier is logical when one considers the basic principles of ergonomics and biodynamics, and the clear evidence that now links small hand size with pain and injury. Increased technical ease relates to pieces being more ‘under the hand’. In addition, a more compact hand reduces stress and discomfort, not to mention improving security, resulting in a more musical and confident performance.

In order to master a wide range of repertoire, concert pianists ideally need have a hand span that accommodates a 10th. Such a span is found in approximately 80% of males but only in about 20% of females. The benefits of smaller keyboards for children are also obvious, in that piano playing is more enjoyable when playing an instrument that fits one's hands.

As smaller keyboards would better suit the majority of children and adult females, it should not be seen as a 'special' product for a niche market. It requires a fundamental change in culture and approaches by manufacturers; ultimately one would imagine that smaller keyboards will be just as common in society as is the current size. In this distant future, one expects that most pianists will come across two or three different sizes during their lives and will be used to adapting, (as many of us do now when switching between automatic and manual cars). For the majority of the casual piano playing public, the piano keyboard size will not make a lot of difference.

5. WHERE TO NEXT?

The authors believe that our ultimate aim should be to convince at least one major piano manufacturer to take the lead in further investment – both in refining the technology for mass production, but also developing the market over many years.

There is much to be done in terms of spreading awareness of the issues and benefits globally. An important barrier to remove relates to exam policy. It is also important for more pianists to actually experience the smaller keyboards and therefore gain an understanding of what it could mean for them and their students. All of these strategies will help to overcome some of the myths and negative attitudes.

Smaller keyboards in universities are an important medium-term goal, as they can serve a number of purposes, such as:-

- providing a career path for talented piano students with small hands
- attracting talented students to the university
- use in further research
- availability for conferences
- use in public performances and competitions.

The authors have already had some papers published, and have developed a website (www.smallpianokeyboards.org) which provides a summary of the research, locations of teachers and universities with smaller keyboards, and other information to assist those lobbying for change around the world. The authors are also collecting hand size data from pianists across the country, the aim being to assess gender differences to compare with other datasets, and hopefully gathering sufficient data to identify ethnic differences.

Further research in universities could focus on rigorous assessments, involving expert panels comparing performances by the same individuals on the conventional compared with a smaller keyboard, and relating such findings to hand size. Other research could focus on specific skills, such as sight-reading, on different keyboards.

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