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Ergonomic Keyboards: Size Does Matter

by **Carol Leone**, International pianist and Chair of Keyboard Studies at SMU Meadows School of the Arts in Dallas, Texas. The world's leading performer, teacher and researcher on ergonomically scaled piano keyboards.

We expect most things in our life to be tailor-made to fit our size. This morning, you got up, put on well-fitting clothes and shoes, and popped on your prescription glasses or contacts. If you drive, you got in your car and adjusted the seat, steering wheel, rear view mirror, and seat belt. Golfers are fitted with proper size clubs to optimize their performance. A ballerina has hundreds of sizes and shapes of pointe shoes to choose from. Think of how particular we pianists are about the importance of adjustable piano stools. Why then, do we persist in the idea that the piano keyboard is "one size fits all?"

Consider the different shapes and sizes of everyone across the globe who plays the piano: children, adults, males, females, university students, amateurs, teachers, professionals, aging pianists---what percentage of them do you think have hand spans that the conventional keyboard ergonomically suits? Hand-size studies reveal it is a very small percentage indeed—perhaps less than twenty percent. Research repeatedly shows us that the healthiest hands are those that remain close to a person's anatomically neutral position when playing the piano. As we know, that size can range widely by several inches/centimeters from person to person.

This article describes the importance and recent rise of the use of piano keyboards with narrower keys for acoustic pianos,

called ergonomically scaled piano keyboards (ESPKs). Before looking at this solution, let's examine the problem people with smaller hand spans have in playing conventional keyboards. Can you or your students relate to any of these challenges?

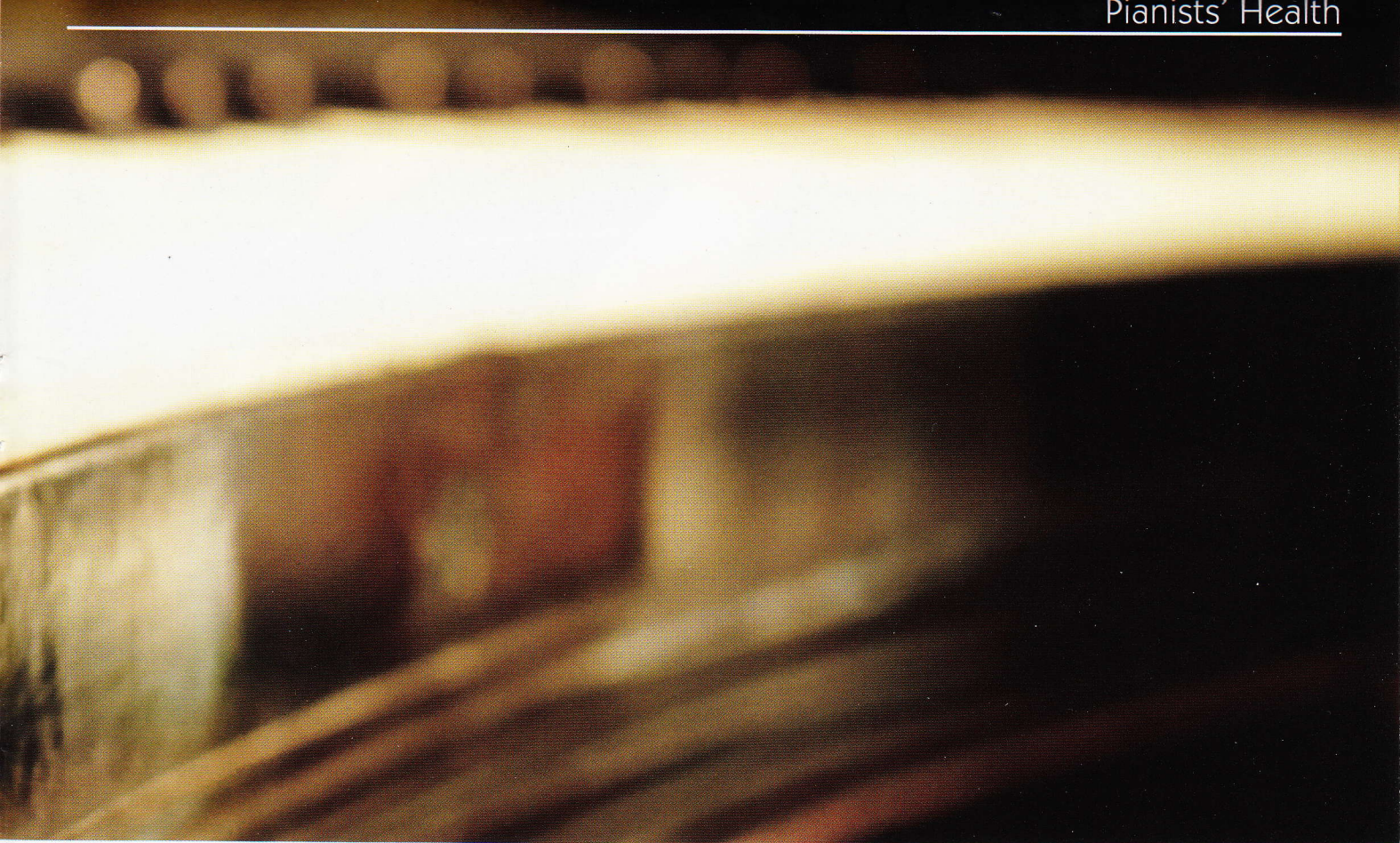
- We have to work physically harder at the piano to achieve the same musical result as pianists with large hand spans.
- We are denied the joy of playing certain large-handed repertoire well.
- We have to work longer at mastering certain passages, in particular those with large chords and octaves.
- We are rarely considered to be "the pianist with the big sound."
- We are more susceptible to injury. Injuries related to playing the piano are at an all-time high, with studies showing that nearly three-quarters of those injuries are related to playing large chords and octaves.

Millions of children studying piano across the globe are playing piano keyboards that do not fit their hands. Therefore, they are not developing a proper hand position and a natural, relaxed approach to the keyboard. In contrast, it is considered sound pedagogical practice to give young string players smaller instruments. Careers of older pianists are shortened, and enjoyment greatly reduced, on our conventional

keyboards. Their hands are no longer as flexible as in youth. Besides the possible onset of arthritis or rheumatism, tendons naturally stiffen with age and are less able to tolerate hours of practice.

Direct mechanical disadvantages of playing the conventional keyboard size with a small hand span are: 1) a raised wrist position, resulting in fingers 1 and 5 becoming "pokers" rather than supple conduits of arm weight; 2) excessive lateral hand movement in which the fingers and hand have to travel farther over wider keys, resulting in stiffer fingers and slower motion; 3) percussive strokes from jumping laterally place to place, rather than fingers being able to play from a starting position close to the keys; and 4) excessive forward and backward motion (as in chromatic octaves, when a hand must play on the front edges of the keys to span an octave.)¹

As a piano professor at an American university that uses ergonomic keyboards, I often witness pianists place their hands for the first time on a keyboard that better fits their hand span. How often the pianist spontaneously bursts into tears. A lifetime of struggling with a seemingly insurmountable problem vanishes in the moment they realize, "It's not me that is the problem; it is the instrument!" Following on that, the joy of possibility overwhelms them.



HAND SPANS AND ESPK SIZES

To understand what might be the ideal keyboard size for you or your students, we must first define hand span size. The average adult male has a 9-inch (23 cm) span; the average adult female has an 8-inch (20 cm) span. Dividing typical hand spans into three ranges, a large span can be defined as reaching 8.8 inches (22 cm) or more (measured with a fully extended hand from the outside of the thumb and fifth finger). Hand span researchers such as Robin Boyle and Erica Booker² have confirmed what most of us already know: large hands spans are most suitable for the conventional keyboard. The octave sizes of the three available ESPKs (5.5, 6.0, and 6.5 inches, respectively) allow small, medium and large hand spans to remain closest to an ideal neutral playing position and allow for the playing of 10ths.

Using the chart below, one can conclude that the majority of children and adult females, as well as a percentage of adult males, are best suited to keyboards smaller than the conventional twentieth century size of 6.5 inches. The keyboard an individual chooses

would depend on the repertoire they want to play and the thickness of their fingers in relation to the black keys.

Just as critical as the span between fingers 1-5 is the span between fingers 2-5. For example, if I want to play the chord C-Eb-C on the conventional keyboard, my fingers 2-5 must stretch 13 cm from key center to key center. Unfortunately, my span between those fingers is only 12.5 cm! The photos below illustrate my hand playing this chord on the three keyboards. Note the changes in the position of my fifth finger and how it is prone to injury on the conventional keyboard when I apply force behind it.

CASE STUDY AT SMU

SMU Meadows School of the Arts in Dallas, Texas, where I chair the keyboard department, has been a center of research and performance for ESPKs since 2000. We have demonstrated that ESPKs can successfully be implemented in a university music school environment. Our ESPKs, the D.S.-5.5 and D.S.-6.0, are made by Steinbuhler & Co. We began a case study on the effects of using an ESPK soon after receiving

our first keyboard installed in a Steinway B. The results were published in the *American Music Teacher* journal in 2003.³ We asked, "How can one adapt to the size?" and "What about going back and forth between the two sizes?" We were surprised to discover that the majority of pianists adjust very easily to the keyboards. Our study indicates that it generally takes less than an hour of practice to feel comfortable. Furthermore, my students and I are comfortable moving easily back and forth between the three keyboards, even within the same recital. During a four-day period in 2014, I successfully recorded a CD recital program using one Steinway D and its three different keyboards (one conventional and two alternate sizes of ESPKs.) It allowed me to include repertoire of all periods, including "stretchy" pieces (such as the first Ballade of Chopin) that I would normally avoid playing.

How does an appropriate ESPK feel? The quietness of the hand and its compactness contribute in a significant way to feelings of comfort, relaxation, security, and more intimacy with the instrument. "I experienced less fatigue and strain on my hands and arms", one student reported. The right ESPK also contributes significantly to technical ease. The hand in an anatomically neutral position allows smaller, more refined movements. Fingerings marked by composers and editors finally make sense. Rolled chords and contrived pedaling to

Small Spans	(<8.2 inches)	D.S. - 5.5 inch octave keyboard (14 cm)
Medium Spans	(8.2-8.8 inches)	D.S. - 6.0 inch octave keyboard (15.2 cm)
Large Spans	(>8.8 inches)	Conventional 6.5 inch octave keyboard (16.5 cm)



D.S.-5.5 inch octave keyboard (14 cm)



D.S.-6.0 inch octave keyboard (15.2 cm)



Conventional 6.5-inch octave keyboard (16.5 cm)

mask notes that are not being held manually are eliminated. The high and low ranges are closer to the body—one does not have to lean as far to the right and left. Other students reported: "I feel a whole new technique for this keyboard. I can get deep into the keys" and "My hand looks so natural—I now have a high, strong bridge."

The most noticeable musical improvement one is able to achieve on an ESPK is a beautiful legato. The pianist also has more power, since a more compact hand is able to deliver more force, weight, and speed than an extended hand. A compact hand more easily achieves proper textures, voicing chords with better results than an extended hand with outstretched fingers. Finally, it follows that with greater technical ease and more efficient motion, one can play fast passages with more velocity.

Piano teachers have to be very clever in devising small hand technical strategies for their students (and ourselves if we also have small hand spans.) We can spend an inordinate amount of lesson time explaining these complicated strategies to students. With the ESPKs, my students and I observed several timesaving improvements in our practice techniques and learning abilities. Because chords and figurations lie easily under the hand, sight-reading is improved and the process of note learning and memorization is accelerated. The practice time required to master the technical aspects of a piece is decreased; therefore there is extra time to devote to musical aspects or to additional repertoire. We have found we can practise challenging passages for a longer period of time without tiring. This improved practice capability has resulted in many students choosing to learn their repertoire on the ESPK first, before playing it on the conventional keyboard.

PREVENTING PLAYING RELATED INJURIES

Given the musical and technical benefits of playing on a keyboard that fits one's hands, it

is easy to make an excellent case for the use of ESPKs. The case becomes more compelling in view of the sad fact that pianists commonly injure themselves on keyboards that are too large. These playing-related musculoskeletal disorders (PRMDs) are characterized by numbness, weakness, and pain that affect or disrupt the musicians' ability to perform. A 2002 study by Sakai⁴ focused on hand pain caused by overuse among professional pianists. In that study, Sakai found that seventy-four percent of onset pain coincided with playing two specific musical textures requiring the hyperabduction of the thumb and fifth finger: octave passages and chords.

Though scientific studies proving a decrease in PRMDs with long-term use of ESPKs have yet to be conducted, compelling anecdotal evidence has emerged at our university during the last fifteen years. Three students in particular were allowed to enroll in our graduate programs despite a long history of debilitating PRMDs. All three reported a dramatic reduction of pain and weakness within the first few weeks of switching to the ESPKs for their practice. Without exception, these students recovered from their injuries and ultimately performed successful, pain-free graduate recitals. While the first half of their recital was performed on the conventional keyboard playing Baroque and Classical repertoire, they performed the second half on the same piano with an ESPK action, playing repertoire containing octave passages and large chords by composers such as Chopin, Rachmaninov and Ginastera.

PHILOSOPHICAL CONCERNS

Breaking with tradition of the conventional 20th century keyboard strikes at the heart of several philosophical and modern societal concerns and benefits, namely: elitism, human well-being, diversity, self-realization, personal integrity, choice and flexibility.

Elitism : The current conventional size is designed for the fortunate few, the lucky minority, leaving the vast majority of children, adult women, and older pianists to struggle. Perhaps you agree with this natural selection process. As one colleague argued, "There are already too many good pianists in the world." My response would be, "Why not more art, more beauty? Let's have millions of pianists in the world making more beautiful music."

Human Well-Being : The International Ergonomics Association (IEA) defines ergonomics as "optimizing human well-being and overall system performance."⁵ Indeed, we must recognize that the instrument itself is not sacred, rather the human is. An instrument is simply "a means whereby something is achieved, performed, or furthered."⁶ Alternate size keyboards place human well-being in its rightful position, above the instrument itself.

Diversity : The IEA explains, "Ergonomics makes things usable to all people, taking into account age, gender, and cultural background." To restate, the average female hand span is smaller than the minimum span believed to be ergonomically suited to the conventional piano keyboard. Gender and diversity were not taken into proper account when this standard was established over 100 years ago. The time is now overdue, especially considering the increased demands on hand span in piano literature of the last century.

Self-realization : The fulfillment of one's own potential is a central ideal for our modern society. When our society has the means and technology to provide instruments for optimum performance, those technologies and advantages will naturally be sought out, regardless of the tyranny of tradition.

Personal Integrity : Why do I play alternate size keyboards? For me, musical integrity is more important than fitting into any outmoded convention. Knowing that my personal musical outcomes have improved significantly with the proper size instrument, I have easily withstood criticism from those who disagree with this idea or even regard it with derision. Those who choose this option can be proud and dignified in the face of disapproval. Know that you are in the good company of those who use and used keyboards with alternate key sizes: Beethoven, Liszt, Josef Hoffman, and Daniel Barenboim⁷, to name a few!

Choice : There are few downsides to having a choice, for alternatives primarily offer the possibility of benefit. One could choose to ignore the alternate sizes, to play them occasionally, to use them in one's teaching studio, to use them in the recording studio, or even to play on them exclusively.

Flexibility : In the eighteenth and nineteenth centuries, keyboard sizes were variable and pianists exercised their adaptability and flexibility. Because of mass industry production, twentieth century keyboards became somewhat constant, and pianists mistakenly bought into the idea that they themselves were as inflexible as the keyboards. Sadly, we became ignorant of our own natural adaptability. Today's pianists should be encouraged to embrace the beauty and freedom of flexibility. Those who move easily from one keyboard size to another recognize the value of this skill to the understanding of overall piano technique.

A VISION FOR THE FUTURE

Why hold the keyboard size a constant in the twenty-first century? If manufacturers regularly produced alternate size keyboards, and if they were readily available in performance venues, might you use the keyboards and would you have your students use them? Pianists all over the globe are now seeking to adopt this new paradigm. The organization PASK (Pianists for Alternate Size Keyboards) is leading an international movement committed to "after change in relation to piano keyboard size". Specifically, PASK seeks to convince piano manufacturers to begin producing pianos with narrower keys and to convince managers of concert venues, academics, piano teachers and piano competition organizers that these ergonomically scaled piano keyboards have significant benefits for students and performers."⁸

Significant progress has been made. ESPKs are available from several manufacturers, such as Steinbuhler & Co and the Charles Walter Piano Company in the USA, Laukhuff Keyboards in Germany, and Kawai Australia. Ten Universities in the US, in Texas, North Carolina, Nebraska, Minnesota, Wisconsin, Oklahoma and Ohio are now using pianos with ESPKs for teaching, performing or research. The first international piano competition that allows ESPKs occurs each March at SMU in Texas, called the Dallas International Piano Competition. On the exam front in Australia, the Australian Music Examinations Board (AMEB) stated that they had no objection to the use of piano keyboards of different sizes for examinations.

Current research includes:

- The SMU research team that I lead is documenting musical and technical outcomes with university and preparatory students.
- Kathleen Riley at the Cleveland Institute of Music is comparing electromyography and motion analysis measurements between the D.S.-5.5 inch keyboard and conventional keyboard.
- Erica Booker in Sydney, Australia will be doing the same with electromyography and children
- Rhonda Boyle in Melbourne, Australia has collected and is analyzing hand span data (fingers 1-5 and 2-5 spans) from over 450 pianists, looking for gender and ethnic differences and describing what it means for piano playing.

INCORPORATING THE ESPK IN THE TEACHING STUDIO

An ideal teaching model for the home or university studio is to have two pianos in the

studio, one with the conventional keyboard and with an ESPK. The student has lessons in the studio on both, with specific repertoire for each piano and the same technique assignments on both. Technique work with increased challenges (such as octaves and large chords) can be added for work on the ESPK.

In the university, the student should have easy access to both sizes for their practice, but for the young student, a possible scenario is to have an ESPK at home and a conventional piano at school or church. Other set-ups at the SMU piano preparatory school use the ESPK only in the studio. The children in the preparatory school have proven to be extremely flexible in this regard, and switch easily from one size to another.

YOU CAN BE INVOLVED IN THIS MOVEMENT

Check out the many online resources available to you, starting with Pianists for Alternative Size Keyboards. Attend a conference or visit a university where ESPKs are available for you to try. Talk to your colleagues about the need for change. Assure piano retailers and manufacturers that there is a ready market. Seek to purchase an upright with an ESPK, an alternate ESPK action for your grand piano, or simply retrofit your current action with narrower keys. You will find that the costs are not exorbitant. Write a grant proposal requesting funds to purchase an ESPK for your school or home studio for the purpose of teaching, playing or research. Let's make good piano playing an equal opportunity, teach our children properly, prevent injuries, expand our repertoire, and realize our own full musical potential! ■

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Resources

1. Rhonda Boyle, "The Benefits of Reduced-Size Piano Keyboards for Smaller Handed Pianists," Australasian Piano Pedagogy Conference Proceedings (July 2013)
2. Erica Booker and Rhonda Boyle, "Piano keyboards – One Size Does Not Fit All!" Australasian Piano Pedagogy Conference Proceedings (July 2011)
3. Carol Leone, "Gol dilocks Had a Choice," American Music Teacher (June-July 2003)
4. Naotaka Sakai, "Hand Pain Attributed to Overuse Among Professional Pianists: a Study of 200 Cases," Medical Problems of Performing Artists (December 2002)
5. The International Ergonomics Association, <http://www.iea.cc>
6. Merriam Webster, <http://www.merriam-webster.com>
7. Michael Kimmelman, "A Whirlwind Named Barenboim", NY Times (November 21, 2008)
8. Pianists for Alternate Size Keyboards, <http://www.paskpiano.org>

Online Resources

- Pianists for Alternate Size Keyboards, www.paskpiano.org, www.facebook.com/pask.piano
- Small Piano Keyboards, www.smallpianokeyboards.org
- Steinbuhler & Co. www.steinbuhler.com
- Dallas International Piano Competition www.dallasipc.org