

ASSESSING PERCEPTION AND ATTITUDE OF PIANISTS TOWARD ERGONOMICALLY  
SCALED PIANO KEYBOARDS (ESPK): RAISING AWARENESS ABOUT ESPK  
AND EVALUATING CHANGES OF ATTITUDE THROUGH  
AN EDUCATIONAL SURVEY

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As epidemiologic research demonstrates health concerns for hand problems among pianists, scientists are measuring historic piano keyboards and realizing that much of the piano literature was composed for and played on pianos with smaller keys compared to what is used on the modern piano. Having to play this literature on a larger keyboard is especially difficult for small-handed piano students and professionals. Fortunately, smaller keyboards are now available for use with standard pianos - and research shows that this ergonomic adjustment does reduce piano-related hand pain for small-handed musicians. Major universities are now offering this option to students, but only a few music schools possess these keyboards and not many people know about them. There are no known research studies to address people's awareness and attitude toward ergonomically scaled piano keyboards (ESPKs). The purpose of this study was to assess perception and attitude toward ESPKs and help to raise its awareness. To examine pianists' perception, two surveys were composed. First one was conducted on UNT campus in which ESPKs are available for their students, and the second survey was carried out on schools of music in the United States. The results reveal that substantial number of people already know about the existence of ESPKs, but they are not totally aware specific information about ESPKs. Subjects who are aware of ESPKs report significantly higher positive attitude compared to those have not known about ESPKs. Results from this study may have implications for health education initiatives within NASM schools of music.

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## LIST OF ABBREVIATIONS

AMEB	Australian Music Examinations Board
ESPK	Ergonomically scaled piano keyboards
IRB	Institutional Review Board
NASM	National Association of Schools of Music
PASK	Pianists for Alternatively Sized Keyboards
PRMD	Playing-related musculoskeletal disorder
SPSS	Statistic Package for the Social Sciences
TTM	Transtheoretical model
UNT	University of North Texas
VAS	Visual analog scale

## CHAPTER 1

### INTRODUCTION

The National Association of Schools of Music (NASM) provides an accreditation standard that states: “Students enrolled in music unit programs and faculty and staff with employment status in the music unit must be provided basic information about the maintenance of health and safety within the contexts of practice, performance, teaching, and listening. Specific methods of providing information and addressing injury prevention, technology, and facilities are the prerogative and responsibility of the institution.”<sup>1</sup> This preemptive approach is critical because students may not realize the importance of prevention until they experience undesirable symptoms. According to one survey, 79% of participants continued to practice after they felt Playing-Related Musculoskeletal Disorder (PRMD) symptoms.<sup>2</sup> Schools should recognize that enforcing practice while experiencing those symptoms may increase the potential for severe health problems. In particular, these concerns related to pianists need to be taken more seriously because evidence suggests that among musicians seeking treatment for music-related injuries each year more than half are keyboard players who suffer from tension and pain in their hands, fingers, and wrists.<sup>3</sup> Because risk is elevated for small-handed pianists,<sup>4</sup> ergonomically modified keyboards are available as an option and potential solution. Unfortunately, this approach is not widely recognized or deployed.

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<sup>1</sup> NASM Handbook 2017-2018, pg. 64-65 under Standard II, F., 1.

<sup>2</sup> Peter Bragge, Andrea Bialocerkowski and Joan McMeeken, “Musculoskeletal Injuries in Elite Pianists: Prevalence and Associated Risk Factors,” *Australian Journal of Music Education* no. 1 (2008): 18-31.

<sup>3</sup> Alice G. Brandfonbrener, "Epidemiology of the medical problems of performing artists," *Sataloff, RT, Brandfonbrener, AG en RJ Lederman, RJ (eds), Textbook of Performing Arts Medicine* (1991): 25-69.

<sup>4</sup> Naotaka Sakai, "Hand pain related to keyboard techniques in pianists." *Med Probl Perform Art* 7, no. 2 (1992): 63-65; Naotaka Sakai, “Keyboard Span in Old Musical Instruments: Concerning Hand Span and Overuse Problems in Pianists,” *Medical Problems of Performing Artists* 23 no.4 (2008): 169-171.

## Diversity of Hand Size

According to Ortmann, hand size and shape are crucial matters for pianists that can influence performance ability.<sup>5</sup> The problem is that the size of the hand varies greatly according to gender and ethnicity. Many researchers measured people's hand sizes, and they found a significant difference between hand span of males and that of females.<sup>6</sup> Boyle et al. found that the average hand span of male pianists is 1 inch (2.5 cm) greater than that of female pianists in their study,<sup>7</sup> and Donison reported that females have 15% smaller hands than males on average.<sup>8</sup> Yoshimura and Chesky's measurements of the hand span of 397 students and pianists at the University of North Texas in 2009 showed more than a 4-inch difference between the smallest hand size of a female student and the largest of a male student.<sup>9</sup> This diversity is confirmed not only across gender but different ethnicities as well. Sakai added that the hand span of German pianists is significantly larger than that of Japanese pianists in his study,<sup>10</sup> and Nag et al. reported that the average hand span of Indian women is 0.9 inches smaller than American women, 0.92 inches smaller than British women, and 0.99 inches shorter than West Indian women.<sup>11</sup> Despite

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<sup>5</sup> Otto Ortmann, *The Physiological Mechanics of Piano Technique* (New York: E.P. Dutton, 1962), 318-319.

<sup>6</sup> Tretip Kamolsiri, "Even a Star Shines in the Darkness; Overcoming Challenges Faced by Pianists with Small Hands" (DMA diss., West Virginia University, 2002); J. Farias et al., "Anthropometrical Analysis of the Hand as a Repetitive Strain Injury (RSI) Predictive Method among Pianists," *Italian Journal of Anatomy and Embryology* 107 no.4 (2002): 225-231.

<sup>7</sup> Rhonda B Boyle and Robin G Boyle, "Hand Size and the Piano Keyboard. Literature Review and a Survey of the Technical and Musical Benefits for Pianists using Reduced-Size Keyboards in North America," *Australasian Piano Pedagogy Conference* (2009); Rhonda Boyle, Robin G. Boyle and Erica Booker, "Pianist Hand Spans: Gender and Ethnic Differences and Implications for Piano Playing," In *Australasian Piano Pedagogy Conference*, Melbourne, 2015.

<sup>8</sup> Christopher Donison, "Hand Size vs the Standard Piano Keyboard," *Medical Problems of Performing Artists* 15, no.3 (2000): 111-114.

<sup>9</sup> Eri Yoshimura and Kris Chesky, "The Application of an Ergonomically Modified Keyboard to Reduce Piano-Related Pain," *Music Teachers National Association E-journal* (2009): 2-13.

<sup>10</sup> Sakai, 169-171.

<sup>11</sup> Anjali Nag, P. K. Nag and Hina Desai, "Hand anthropometry of Indian Women," *Indian Journal of Medical Research* 117 (2003): 260-269.

this vast diversity of hand size, the piano community largely conforms to the standard size keyboard as a one size fits all approach.

### Definition of Small Hands

Researchers reported varied and differing opinions about how to define a small hand. For example, Kamolsiri describes those who cannot play an 8<sup>th</sup> interval comfortably and/or unable to reach a 9<sup>th</sup> interval as small handed.<sup>12</sup> David Steinbuhler defined small hands as those with a thumb to fifth finger (1-5) span of 8 inches or less, a concept used in the studies by Wrysten and Hallbeck in 2009.<sup>13</sup> However, Farias et al. classified small hands as those unable to reach a 10<sup>th</sup> interval.<sup>14</sup> This view is supported Boyle et al.<sup>15</sup> and added an important concept regarding “comfortable” playing of the octave which includes playing legato octaves and fast octave movements.<sup>16</sup> A hand span of 8.5 inches is required to play these octaves comfortably (without tension and stretching), and this span can reach a 10<sup>th</sup> easily. Boyle also added that the index finger to the fifth finger (2-5) span along with 1-5 span is crucial to determine small hands. She mentioned that a 2-5 span of 6 inches is required to play wide chords or broken chords of a 7<sup>th</sup>. Therefore, a hand span (1-5 span) less than 8.5 inches or/and less than 6 inches of a 2-5 span is defined as a small hand. These definitions are widely used in the Pianists for Alternatively Sized Keyboards (PASK) societies and their studies.<sup>17</sup> Hand span data collected from 473 pianists in

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<sup>12</sup> Kamolsiri, 2002.

<sup>13</sup> Brenda Wrysten and M. Susan Hallbeck, “The 7/8 Piano Keyboard: An Attractive Alternative for Small-Handed Players,” *Update: Applications of Research in Music Education* 28, no.1 (2009): 9-16.

<sup>14</sup> Farias et al, 225-231.

<sup>15</sup> Boyle et al., 2015.

<sup>16</sup> Rhonda Boyle, “The Experience of Playing Reduced-Sized Piano Keyboards: Survey of Pianists,” *Music Teachers National Association e-journal* 3, no.4 (2012): 2-20.

<sup>17</sup> Carol Leone, “Size is Key,” *Clavier Companion, Frances Clark Center for Keyboard Pedagogy, USA*, Sep/Oct. (2015): 11-21; Lora Deahl and Brenda G. Wrysten, *Adaptive Strategies for Small-Handed Pianists*. (Oxford

Boyle and Booker’s study showed that 23.8% of males and 87.1% of females were defined as small-handed pianists based on this classification.<sup>18</sup> This finding underscores the idea that a considerable portion of pianists are at risk when using a standard size keyboard.

### Effort to Extend Hand Flexibility

To overcome the lack of options to increase the genetically determined size of hands, some have tried to stretch and make hands more flexible. Pedagogues composed specific pieces to help gradually stretch hands. Figure 1 is one excerpt of progressive exercises by pianist Leopold Godowsky that he titled “For Stretching and Making the Fingers Independent.” Each finger needs to be extremely extended to play this excerpt.



Figure 1. Godowsky’s stretching exercise <sup>19</sup>

University Press. 2017); “How Many Pianists Have Small Hands, “Alternatively Sized Piano Keyboards, accessed December 1, 2017, <http://www.smallpianokeyboards.org/how-many-pianists-have-small-hands.html>.

<sup>18</sup> Rhonda Boyle, Robin G. Boyle and Erica Booker, “Pianist Hand Spans: Gender and Ethnic Differences and Implications for Piano Playing,” In *Australasian Piano Pedagogy Conference*, Melbourne, 2015.

<sup>19</sup> St. Louis Art publication Society, 1913.

In addition to technical exercises on the keyboard, physical devices were also created. Frederick Crane of Massachusetts invented a mechanical device called “Hand Extender” in which two finger slings were affixed on a rod forcing two fingers apart as shown in Figure 2. Scholars considered that these approaches might cause serious damage to the hand.<sup>20</sup>

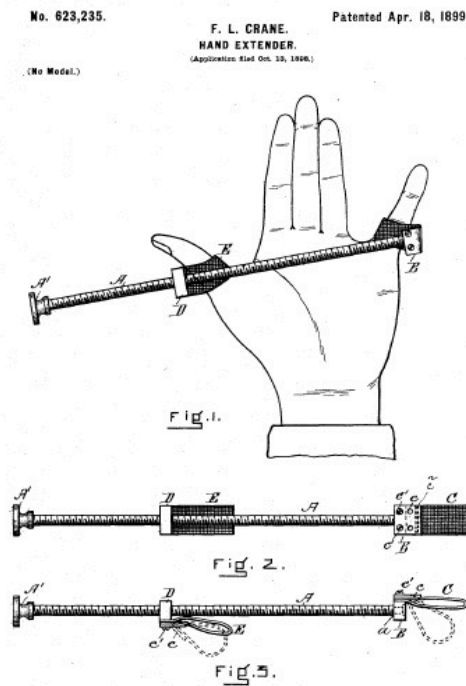


Figure 2. Hand extender by Frederick Crane, 1899

### Small Hands as a Risk Factor

Many researchers found that small hands are a significant risk factor.<sup>21</sup> Sakai pointed out that playing ‘wide-hand-positioned techniques’ such as octaves and chords is difficult for small

<sup>20</sup> Lora Deahl and Brenda Wristen, “Strategies for small-handed pianists,” *American Music Teacher* 52 no.6 (2003): 21-25. Alice G. Brandfonbrener, “The Etiologies of Medical Problems of Performing Artists,” in *Performing Arts Medicine*, 2nd ed., eds. Robert Thayer Sataloff, Alice G. Brandfonbrener, and Richard J. Lederman (San Diego: Singular, 1998), 28.

<sup>21</sup> Sakai, 63-65; Sakai, 169-171; Eri Yoshimura, Pamela M. Paul, Cyriel Aerts, and Kris Chesky, “Risk Factors for Playing-related Pain among College Students,” *Medical Problems of Performing Artists* 21 no.3 (2006): 118-125; Christine Zaza and V. T. Farewell, “Musicians’ playing-related musculoskeletal disorders: An examination of risk factors,” *American Journal of Industrial Medicine* 32, no. 3 (1997): 292-300.

handed pianists and increases the risk to the hands.<sup>22</sup> The University of Melbourne and the Victorian College of the Arts conducted a survey on the risk factors for injury in elite pianists. Along with technique, muscular tension, style of teaching, seat height, and repertoire, hand size was nominated as one of six important factors.<sup>23</sup> Yoshimura also found that hand size, in particular the span between middle and ring finger, was a risk factor for PRMD.<sup>24</sup> Because of the huge variability of hand size across gender and ethnicity, some assume that females may suffer more pain than males. In fact, researchers found that upper-extremity musculoskeletal problems among keyboard instrumentalists are significantly more prevalent among women.<sup>25</sup> Sakai also added that Asian female pianists would have more trouble playing specific techniques that may cause hand injuries.<sup>26</sup> As mentioned earlier, this risk is not fully realized until symptoms manifest. According to a report by Bragg et al., 79% of participants continued to practice after they felt pain and tension in their body.<sup>27</sup> Ignoring such warning signs and continuing to practice may increase the risk of more serious injuries.

### Limitations of Small-Handed Pianists

In addition to increasing the risk for health concerns, small-handed pianists face obvious technical difficulties. Regardless of the idea that every pianist faces some technical challenges, it

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<sup>22</sup> Sakai, 63-65.

<sup>23</sup> Peter Bragg, et al., "Piano Teachers' Perceptions of Risk Factors Associated with Injuries in Elite Pianists," *Australian Journal of Music Education* 1 (2006): 70-81.

<sup>24</sup> Yoshimura et al., 118-125.

<sup>25</sup> Chong Pak and Kris Chesky, "Prevalence of Hand, Finger, and Wrist Musculoskeletal Problems in Keyboard Instrumentalists: The University of North Texas Musician Health Survey," *Medical Problems of Performing Artists* 16 no.1 (2001):17-23.

<sup>26</sup> Sakai, 167-171.

<sup>27</sup> Bragge et al., 18-31.



is undeniable that small-handed pianists are more likely to struggle with technical challenges. Playing octaves, including legato or fast octaves, large chords and arpeggios are fundamental techniques for pianists but can be difficult for some pianists with small hands. To master these passages cleanly, pianists often repeat technical passages over and over until they are satisfied with their playing. Sakai was concerned about this constant practice of specific techniques because it frequently causes pain and overuse problems.<sup>28</sup> In addition to increasing risk, the extended time used to practice and mastering certain passages distracts from practicing the whole piece.

Small-handed pianists are also potentially limited by the particular technical difficulties of certain piano writing. To overcome these challenges, they often resort to modification such as redistribution, removing notes and rolling chords. However, this produces empty and powerless sonorities, and this insufficient sound often results in unsatisfying performances compared to that of larger handed pianists. In addition, pianists struggle to find effective fingering that overcome their limitations. This can take considerable time, and increases the overall time for mastering the piece.

Small hands can also limit pianists' repertoire and their careers. These challenges lead to a more cautious approach to choosing repertoire. They may try to avoid playing late romantic or contemporary music which can contain technical demands to maximize the sound effects of a piano. Their tendency of avoiding this repertoire restricts their careers as well. Because many international competitions require this repertoire, small-handed pianists may decide to limit their participation in competitions altogether. Perhaps this explains why male winners far exceed the

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<sup>28</sup> Naotaka Sakai, "Hand Pain Attributed to Overuse among Professional Pianists: A Study of 200 cases," *Medical Problems of Performing Artists* 17 (2002): 178-180.

number of female winners in most major competitions- except in Mozart and Bach competitions where the keyboard writing is more accessible to small-handed pianists.

*Table 1. International piano competition winners* <sup>29</sup>

Competition	Total Number of Winners		Number of first prize winners	
	Male	Female	Male	Female
Van Cliburn	39	7	14	2
Leeds	74	25	16	2
Sydney	83	21	9	2
Cleveland	78	24	16	5
Tchaikovsky	43	8	11	1
Gina Bachauer	65	14	14	2
Liszt	31	11	10	1
Arthur Rubinstein	34	10	14	0
Chopin (since 1955)	54	34	9	2
Beethoven	32	20	8	5
Mozart (Italy 17years & above)	25	51	6	16
Bach	16	21	2	2

### Size of Historical Keyboards

The width of keyboards has not consistently stayed the same size across music history.<sup>30</sup>

When Sakai investigated historical keyboard sizes, he found that a lot of music of major composers such as Beethoven, Schumann, Schubert, Chopin, and Liszt, was composed using

<sup>29</sup> “Piano Competition Results,” *Alternatively Sized Piano Keyboards*, accessed May 15, 2017, <http://www.smallpianokeyboards.org/piano-competition-results.html>; Erica Booker and Rhonda Boyle, “Piano keyboard –one size does not fit all! Pianistic health for the next generation,” In *Proceedings of the 10th Australasian Piano Pedagogy Conference: Leading Notes to Effective Teaching: Resolving the past-Exploring the future* (2011): 2-29.

<sup>30</sup> Hunter J. H. Fry, “Overuse Syndrome in Musicians- 100 Years Ago: An Historical Review,” *Medical Journal of Australia* 145 (December 1986): 623.

smaller keyboard.<sup>31</sup> Figure 3 shows the octave span of historical keyboards. A one octave span of Cristofori's piano was 188mm which is very similar to that of modern pianos.

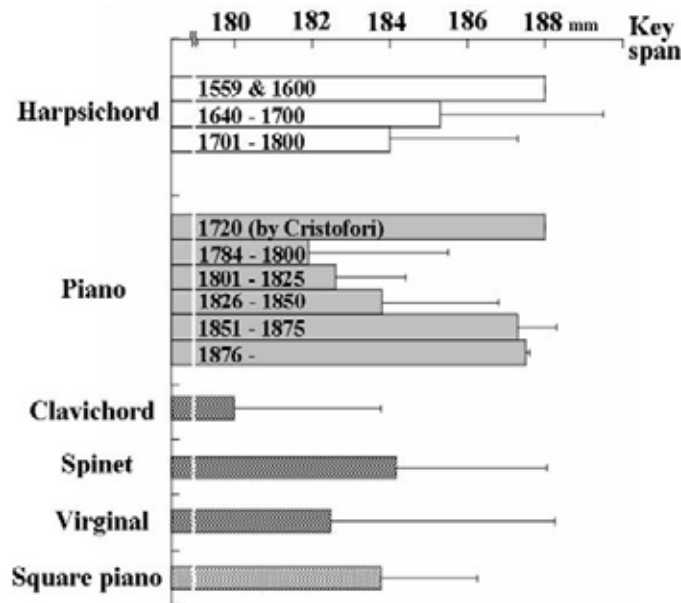


Figure 3. Octave span of historical keyboards size<sup>32</sup>

By 1784, the span had dropped to 181.9mm ( $\pm 3.6$ mm), and it remained that closely until 1850. Sakai pointed out that some pianists suffer from technical difficulties when playing music composed during this period because of the increased keyboard width of the standard keyboard width used today.

### Introduction of Ergonomically Scaled Piano Keyboards

The ergonomically scaled piano keyboard (ESPK) was introduced as an alternative to the standard keyboard in order to reduce piano-related hand pain for small-handed pianists. In the late 1970's Christopher Donison had the keyboard built, and in the early 1990s, Christopher had

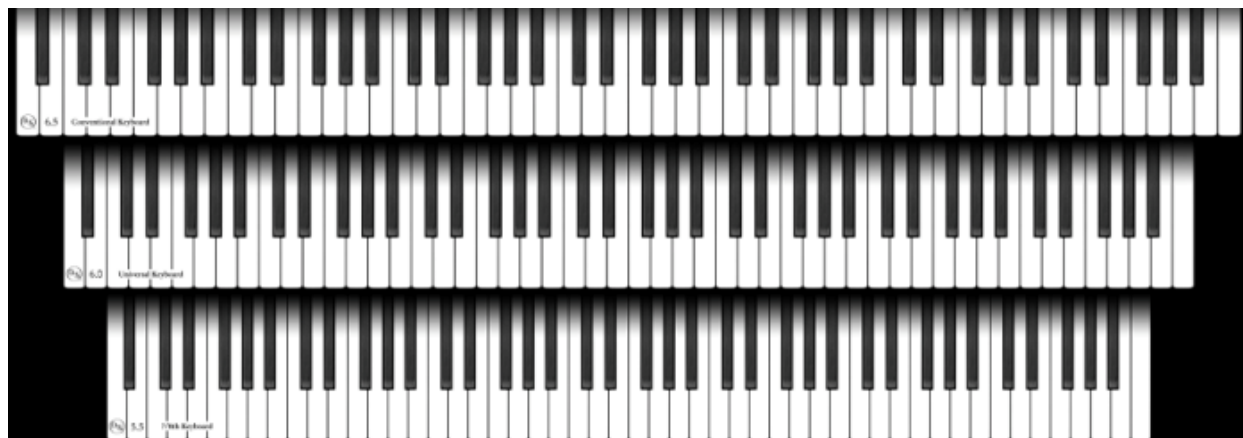
<sup>31</sup> Sakai, 169-171.

<sup>32</sup> Sakai, 169-171.

developed ESPKs with one keyboard company- Steinbuhler. They have offered two different narrower keyboards; DS 6.0 Universal, DS5.5 7/8. Table 2 and Figure 4 show the specific width comparison of two different keyboards with a conventional keyboard.

*Table 2.* Keyboard options from Steinbuhler Co.

Name of keyboard	Width of octave	Overall width of 88 keys
Conventional Keyboard	6.5 inches or 16.5 cm	48.25 inches
DS 6.0™ Universal Keyboard	6 inches or 15.2 cm	44.53 inches
DS 5.5™ 7/8 Keyboard	5.5 inches or 14.1 cm	41.11 inches



*Figure 4.* Different sized piano keyboards by Steinbuhler Co. (From top, conventional-6.5, DS 6.0 universal, DS5.5 7/8 keyboard)<sup>33</sup>

In fact, this is not the first attempt to make narrower keyboards. A Czech company had produced narrower keyboards for ‘ladies’ in the late 1800s, and Steinway and sons designed a special piano for a famous pianist, Joseph Hoffmann, in the beginning of 20<sup>th</sup> century.<sup>34</sup> However, most people cannot expect to easily find a keyboard especially designed for them. In this sense, producing narrower piano keyboards for the public is a positive change.

<sup>33</sup> “Keyboard Size- Brief History,” Alternatively Sized Piano Keyboards, accessed December 1, 2017, <http://www.smallpianokeyboards.org/index.html>.

<sup>34</sup> Booker and Boyle, 2-29; “About This Website,” Alternatively Sized Piano Keyboards, accessed May 15, 2017, <http://www.smallpianokeyboards.org/about-this-website.html>.

## Advocating Alternate Size Keyboards

As many researchers reported advantages of small keyboards, a new advocacy organization, Pianists for Alternate Size Keyboards (PASK), was created.<sup>35</sup> PASK is leading an international movement designed to convince piano manufacturers to support this idea and to encourage managers of concert venues, academics, piano teachers, and piano competition organizers to be aware of significant benefits of ESPKs for students and performers. These small keyboards are now available from several manufacturers including Steinbuhler & Co and the Charles Walter Piano Company in the USA, Laukhuff Keyboards in Germany. Along with University of North Texas (UNT), ten known universities across the U.S., including some in Texas, North Carolina, Nebraska, Minnesota, Wisconsin, Oklahoma, Illinois, and Ohio are using ESPKs for teaching, performing, and research. Since 2014, the Dallas International Piano Competition has offered this option to their competitors. Valery Kuleshov International Piano Competition in Oklahoma has also provided an ESPK since 2016. The Donison Steinbuhler Foundation opened demonstration centers where pianists can experience ESPKs.<sup>36</sup> In Australia, New South Wales branch of the Australian Music Examinations Board (AMEB) stated that they had no objection to the use of piano keyboards of different sizes for examination.

## Advantages of ESPK

Yoshimura confirmed that the use of ESPKs resulted in greater comfort and less pain, stretching, and tension. The reported levels of pain while playing on the 174mm keyboard

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<sup>35</sup> “What is PASK,” Pianists for Alternatively Sized keyboards, accessed May 12, 2017, <http://www.paskpiano.org/index.html>.

<sup>36</sup> “What We Do,” DS Standard Foundation, accessed March 10, 2018, <http://www.dsstandardfoundation.org>.

(ESPK) were significantly less than those on the 188mm (standard) keyboard.<sup>37</sup> Not only the benefits of relief of pain but technical advantages were also reported. Boyle also surveyed people who used these modified keyboards and they reported merits of ESPKs. Among them, most participants confirmed ‘Considerable’ or ‘Dramatic’ improvements on ESPKs related to the ‘Ability to hold down notes as intended rather than releasing early and masking with sustaining pedal,’ ‘feeling of power where needed,’ ‘fast passages of octaves or large chords,” and ‘time taken to master technically difficult passages.’<sup>38</sup> Pianists who regularly used ESPK also reported advantages including progress in various techniques such as leaps, legato playing, broken octaves, broken chords/ arpeggios, and changes of hand position.<sup>39</sup> They further pointed out the better quality of musical expression with accuracy, voicing, legato and musical line, octave legato, and increased power on ESPKs.

### Purpose of This Study

Despite these advantages, only a limited number of schools support this option. To date, there are no known studies designed to assess and understand the reluctance to use these keyboards. The research literature is unclear as to whether this omission is due to lack of awareness, knowledge, or negative attitudes. One of the reasons may be the lack of awareness about ESPK. According to the Transtheoretical Model (TTM), health behavior change involves progress through a series of six stages (pre-contemplation, contemplation, preparation, action, maintenance, termination), and ‘Consciousness Raising’ is one of the most empirically supported

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<sup>37</sup> Yoshimura and Chesky, 2-13.

<sup>38</sup> Boyle, 2-20.

<sup>39</sup> Carol Leone, “Goldilocks had a choice,” *The American Music Teacher* 52, no.6 (2003): 26-29; Donison, 111-114; Boyle and Boyle, 2009.

processes to progress from stage to stage.<sup>40</sup> Consciousness raising involves increased awareness about the cause, sequences, and treatment of certain problem behaviors. Therefore, raising awareness is often required to move forward to the next stage. Before expecting the diffusion of usage of modified keyboards, and change of social attitude about these keyboards, it is necessary to know how many people know about these keyboards, and what they are thinking about them. Therefore, the purpose of this study is to assess the awareness of ergonomically scaled piano keyboards (ESPKs) to prevent pain and injury and to investigate the attitude to using those keyboards as an alternative to standard keyboards for small-handed pianists. In addition, this study will provide an educational intervention in order to better understand the influence of education on attitude toward ESPKs.

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<sup>40</sup> James O. Prochaska and Wayne F. Velicer, "The Transtheoretical Model of Health Behavior Change," *American Journal of Health Promotion* 12, no.1 (1997): 38-48.

## CHAPTER 2

### SURVEY 1: AWARENESS AND ATTITUDE OF PROFESSIONAL KEYBOARD PLAYERS TOWARD ESPK AT THE UNIVERSITY OF NORTH TEXAS

#### Methods

##### Subjects

Subjects included a convenience sample of piano major students of the UNT who were seeking Bachelor, Master or Doctorate degrees or Artist Certificate, regardless of race or gender. Forty-nine piano performance major students participated, and they were between the ages of 19 to 41.

##### Procedures

After International Review Board (IRB) approval, subjects were recruited through personal contact in the music department of UNT and were invited to participate in this study by answering a questionnaire. Each subject signed an IRB consent form and participated in 1 session taking about 5-10 minutes.

##### Questionnaire

The questionnaire consisted of; 1) demographics, 2) hand pain, 3) awareness and knowledge of ESPKs, 4) interests about ESPKs, 5) choice of repertoire and 6) subjects' attitude toward ESPKs. Twenty-two questions were asked, and subjects responded their agreement by marking on a Visual Analog Scale (VAS). The score was recorded on a scale of 0 to 10. Demographic questions include age, gender, country of origin, years of playing the piano, degree sought, and whether or not they taught piano lessons to assess variables. Depending on the



question, the VAS ranged from; *do not agree* (0) to *agree* (10), *not at all* (0) to *very much* (10), *small* (0) to *large* (10), and *smaller* (0), *same* (5) to *larger* (10). Following the questions, subjects were instructed to place their hand on the questionnaire and mark their maximum hand span.

## Data Analysis

Following successful collection of data from 49 subjects, parametric and non-parametric statistical analyses were performed using Statistic Package for the Social Sciences (SPSS). In addition to descriptive statistics, comparison across gender were computed using chi square and *t*-test.

## Results

### Demographics

Table 3 shows the demographics of subjects. Thirty-seven females and twelve males participated. Their average age was 28.96 ( $\pm 4.6$ ) years old and their ages ranged from 19 to 41 years. Among subjects, thirty-four participants (71.5%) were from Asia including Korea (51%), China (10.2%), Taiwan (8.2%), and Japan (2.1%). Eleven subjects (23.6%) reported Caucasian including five American (10.2%), two Hungarian (4.1%), two Polish (4.2%), two Russians (4.1%), one Kazakh (2.1%), and one Israeli (2.1%). Thirty-two subjects (68.8%) were in the doctorate program, seven students (14.6%) were pursuing bachelor's degree, and six subjects (2.5%) were in the master's program. Their average of years playing the piano was 22.21 ( $\pm 5.37$ ) years, and thirty-two subjects (65.3%) regularly taught piano lessons. There were no significant differences across gender for age, degree sought, and years of playing the piano.

Table 3. Demographics of subjects

Variables		Total	Male	Female	Test	Sig.
Number of subjects		49	12	37		
Avg. Age (SD)		28.96 ( $\pm$ 4.6)	29.09 ( $\pm$ 6.73)	28.92 ( $\pm$ 3.92)	t	0.92
		N (%)	N (% within Gender)	N (% within Gender)		
Country of Origin	Korea	25 (51%)	2 (16.7%)	23 (62.2%)	X <sup>2</sup>	0.004**
	USA	5 (10.2%)	3 (25%)	2 (5.4%)		
	China	5 (10.2%)	0	5 (13.5%)		
	Taiwan	4 (8.2%)	1 (8.3%)	3 (8.1%)		
	Japan	1 (2.1%)	0	1 (2.7%)		
	Hungary	2 (4.1%)	1 (8.3%)	1 (2.7%)		
	Poland	2 (4.1%)	2 (16.7%)	0		
	Russia	2 (4.1%)	2 (16.7%)	0		
	Kazakhstan	1 (2.1%)	0	0		
	Israel	1 (2.1%)	0	0		
	Unanswered	1 (2.1%)	1 (8.3%)	1 (2.7%)		
Degree Sought	Bachelor	7 (14.6%)	2 (18.2%)	5 (13.5%)	X <sup>2</sup>	0.93
	Master	6 (12.5%)	1 (2.1%)	5 (13.5%)		
	Doctorate	33 (68.8%)	8 (72.7%)	25 (67.6%)		
	Artist Certificate	1 (2.1%)	0	1 (2.7%)		
	Unanswered	1 (2.1%)	0	1 (2.7%)		
Avg. Years playing the Piano (SD)		22.21 ( $\pm$ 5.37)	20.73 ( $\pm$ 5.80)	22.67 ( $\pm$ 5.24)	t	0.30
Teaching Piano lesson	Yes	32 (65.3%)	7 (58.3%)	25 (51.7%)	X <sup>2</sup>	0.81
	No	12 (24.5%)	4 (33.3%)	8 (21.6%)		
	Unanswered	4 (10.2%)	1 (8.3%)	4 (10.8%)		

\*\*significant at  $p < 0.01$

## Hand Span

Hand measurement was taken. The 1-5 span of the right hand was measured. Table 4 shows that similar to previous hand studies, the average hand span of males in his cohort were significantly larger (2.33cm ( $\pm 1.45$ ) = 0.92 inches) compared to females. Figure 5 is the distribution chart of hand spans. Female hand spans (red bars) ranged from 18.5cm (7.28 inches) to 22.5cm, (8.86 inches) and they distributed to the left, while male hand spans (blue bars) distributed from 20.5cm (8.07 inches) to 15.5 cm, (10.04 inches), and spread to the right. The smallest hand span was 18.5cm (7.28 inches) of a Korean female pianist, and the largest span was 25.5cm (10.04 inches) of a Hungarian male. The difference between them reached to 7cm (2.76 inches). The result confirmed the huge differences of hand span among pianists across gender and ethnicities. Based on Boyle's definition of small hands (less than 21.59cm, 8.5 inches), 34 out of 37 females (92%) and 3 out of 12 males (25%), a total 40 subjects (75.5%) have small hand spans.

*Table 4. Hand span*

	Total Mean (SD)	Male Mean (SD)	Female Mean (SD)	<i>t</i> -test Sig.
Avg. Hand span- cm (SD)	20.82 ( $\pm 1.45$ )	22.58 ( $\pm 1.34$ )	20.25 ( $\pm 0.93$ )	0.000***

\*\*\*significant at  $p < 0.001$

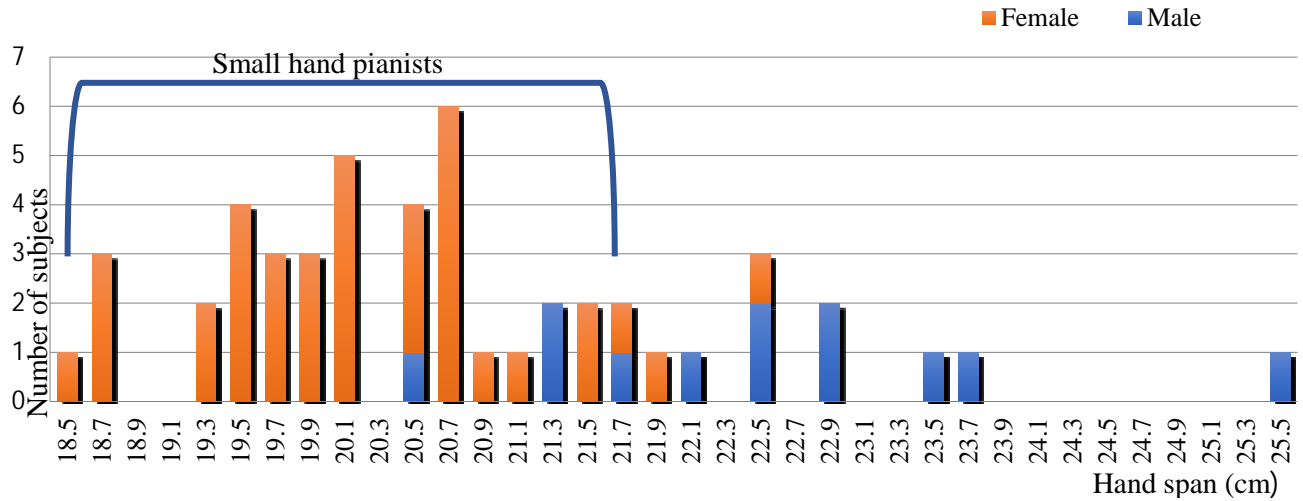


Figure 5. Distribution chart of hand spans

#### Estimate Hand Size and Desired Hand Size

Subjects were asked to estimate their hand size in question no.4, and their response ranged from 0.0 (*small*) to 10.0 (*large*) on VAS. They also marked their desired hand size on VAS ranging from -5 (*smaller*), 0 (*same*), and to 5 (*larger*) in the question no.5. There were significant differences across gender for both estimated hand size and desired hand size. The average of estimated hand size was 4.38 ( $\pm 1.98$ ) in the female group and 6.84 ( $\pm 1.97$ ) in the male group. The average level of desired hand size was 7.70 ( $\pm 2.09$ ) for females and 5.89 ( $\pm 1.08$ ) for males (Table 5). Females estimated their hand size to be much smaller and desired their hand size to be much larger than males.

Table 5. Differences across gender for estimated hand size and desired hand size

	Total Mean (SD)	Male Mean (SD)	Female Mean (SD)	t-test Sig.
Estimate your hand size VAS= 0-10	4.99 ( $\pm 2.22$ )	6.84 ( $\pm 1.98$ )	4.38 ( $\pm 1.98$ )	0.000***
Do you wish your hand size was different? VAS= (-5)-(+5)	2.25 ( $\pm 2.04$ )	0.89 ( $\pm 1.08$ )	2.70 ( $\pm 2.09$ )	0.006**

\*\*significant at 0.01; \*\*\* significant at 0.001.

Regarding the question, “Do you wish your hand size was different?” thirty-six pianists (73% of participants) wanted to have larger hands, and 12 subjects (24%) were satisfied with their hand size. As shown in Figure 6, estimated and desired hand sizes were associated with measured hand size. As expected, subjects with small hands wished for larger hand sizes much more than those with larger hands.

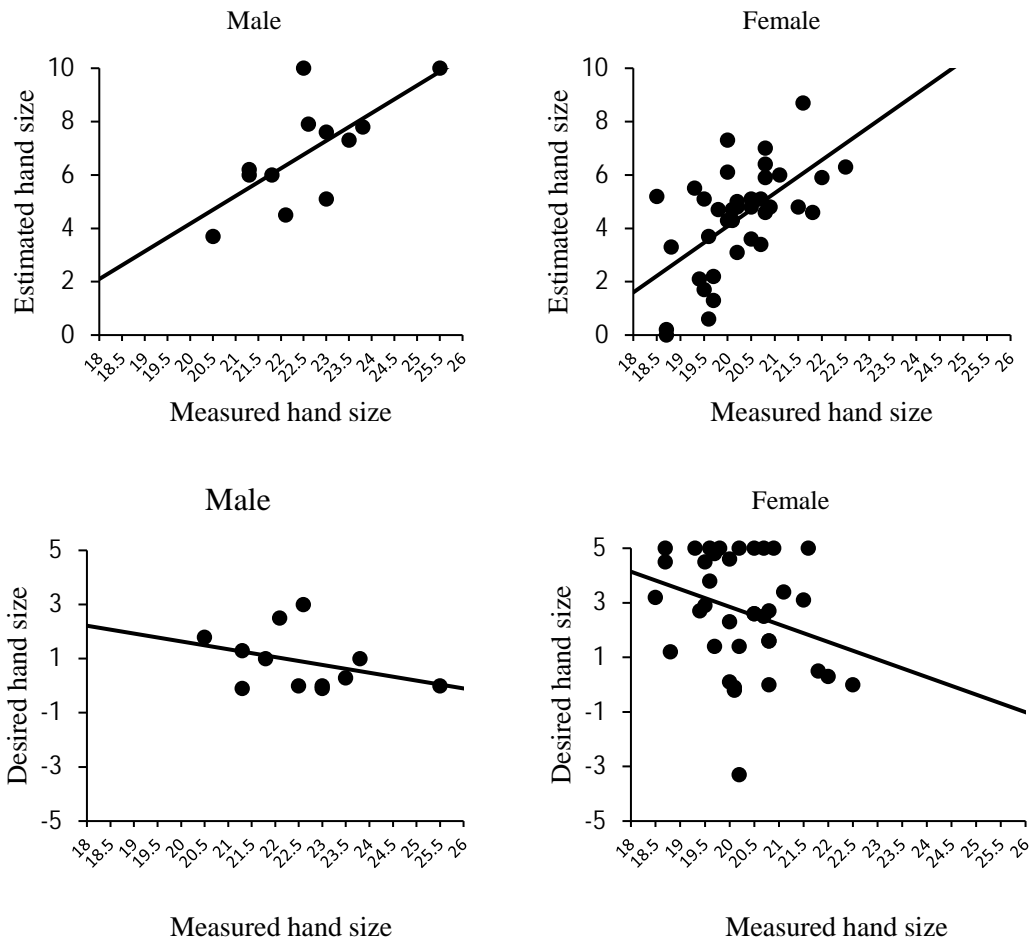


Figure 6. Estimated and desired hand size

## Pain

The mean of the participants’ agreement with the assumption of experiencing hand, finger, and wrist pain was 6.06 ( $\pm 3.13$ ) among piano players at UNT (Table 6). They reported

that hand size does influence pain. The subjects' awareness about the relation between pain and hand size was little more than moderate level 5.43 ( $\pm 3.2$ ).

*Table 6. Pain*

Variables	Total Mean (SD)	Male Mean (SD)	Female Mean (SD)	<i>t</i> -test Sig.
Piano players at UNT experience hand, finger, or wrist pain.	6.06 ( $\pm 3.13$ )	6.25 ( $\pm 3.31$ )	6.00 ( $\pm 3.11$ )	0.813
How much does pianists' hand size influence pain?	5.43 ( $\pm 3.20$ )	5.28 ( $\pm 3.49$ )	5.48 ( $\pm 3.15$ )	0.859

#### Awareness/Knowledge

A large number of subjects ( $n=45$ , 91.8%), reported that they had seen a piano with narrower keys, and 73.5% participants ( $n=36$ ) had tried one. Subjects show a moderate level of awareness and knowledge about historical key sizes and the differences hand size based on race and ethnicity (Table 7). Participants were likely to agree that men have bigger hands than women and using narrower keyboards may reduce hand tension, pain, and injury among small-handed pianist, and the average of VAS degree was quite high.

*Table 7. Awareness and knowledge*

Variables	Total Mean	Male Mean(SD)	Female Mean(SD)	<i>t</i> -test Sig.
Are you familiar with pianos that have narrower piano keys?	4.22 ( $\pm 3.46$ )	5.97 ( $\pm 3.82$ )	3.65 ( $\pm 3.19$ )	0.043*
Generally, men have bigger hands than women.	7.87 ( $\pm 1.99$ )	6.7 2( $\pm 2.54$ )	8.25 ( $\pm 1.65$ )	0.019*
Hand size is related to race and ethnicity.	5.52 ( $\pm 3.35$ )	4.67 ( $\pm 3.72$ )	5.80 ( $\pm 3.23$ )	0.313
Piano key width has changed over time.	5.88 ( $\pm 3.01$ )	6.38 ( $\pm 3.16$ )	5.72 ( $\pm 2.99$ )	0.514

*(table continues)*

Variables	Total Mean	Male Mean(SD)	Female Mean(SD)	<i>t</i> -test Sig.
Most piano music composed between 1750 and 1850 was written using pianos with narrower keys compared to contemporary pianos.	5.92 (±3.34)	5.66 (±3.73)	6.01 (±3.25)	0.754
Some music departments offer pianos with narrower keys to their students.	6.15 (±2.83)	5.47 (±3.93)	6.37 (±2.40)	0.342
Using narrower keys may reduce hand tension, pain, and injury among small-handed pianists.	7.09 (±2.93)	5.78 (±3.39)	7.52 (±2.67)	0.074

\*significant at  $p < 0.05$

### Attitude

Piano students were likely to have a positive attitude toward knowing about this option and offering it in a college or university setting. The degrees of agreement are above moderate levels as shown in Table 8. Also, the degree of agreement about these keyboards as a trick is relatively low. However, participants were less likely to agree that competitions should allow this option.

*Table 8. Attitude*

Variables	Total Mean(SD)	Male Mean(SD)	Female Mean(SD)	<i>t</i> -test Sig.
Piano students should know about pianos with narrower keys.	5.71 (±3.43)	7.18 (±3.40)	5.34 (±3.35)	0.089
Music departments in colleges or universities should offer pianos with narrower keys for their students.	6.12 (±3.30)	6.89 (±3.63)	5.87 (±3.20)	0.356
Using pianos with narrower keys is a trick.	4.33 (±3.25)	4.08 (±3.68)	4.42 (±3.14)	0.761
Competitions should allow competitors the option of using pianos with narrower keys.	4.93 (±3.45)	4.63 (±3.86)	5.02 (±3.35)	0.729

## Choice of Repertoire

The degree of agreement about hand size influencing the choice of piano repertoire is more than 5 on Table 9. However, the degree of agreement about selecting repertoire based on hand size was pretty low.

*Table 9. Choice of repertoire*

Variables	Total Mean(SD)	Male Mean(SD)	Female Mean(SD)	<i>t</i> -test Sig.
Does hand size influence choices of piano repertoire?	5.18 ( $\pm$ 3.14)	3.93 ( $\pm$ 3.31)	5.59 ( $\pm$ 3.02)	0.112
Do you select repertoire based on your hand size?	3.54 ( $\pm$ 3.39)	2.32 ( $\pm$ 2.91)	3.94 ( $\pm$ 3.48)	0.152

## Interest

Table 10 shows subjects' further interest in ESPKs, and they are quite low. Their interest in learning and trying ESPKs was 3.14 ( $\pm$ 3.25) and learning more about the widths of piano keys was 3.82 ( $\pm$ 2.92). The degree of agreement about their interest in health benefits of ESPKs was 4.55 ( $\pm$ 3.33). Although over 73% of participants had tried playing on the ESPKs, it is a quite low level of further interest.

*Table 10. Interest*

Variables	Total mean(SD)	Male Mean(SD)	Female Mean(SD)	<i>t</i> -test Sig.
Are you interested in learning more about pianos with narrower keys?	2.88 ( $\pm$ 2.73)	2.45 ( $\pm$ 2.91)	3.02 ( $\pm$ 2.68)	0.531
You are interested in trying narrower piano keyboards.	3.14 ( $\pm$ 3.25)	2.48 ( $\pm$ 3.12)	3.36 ( $\pm$ 3.30)	0.424
Are you interested in learning more about the widths of piano keys?	3.82 ( $\pm$ 2.92)	3.88 ( $\pm$ 3.14)	3.80 ( $\pm$ 2.89)	0.930

*(table continues)*



Variables	Total mean(SD)	Male Mean(SD)	Female Mean(SD)	t-test Sig.
Are you interested in learning more about the health benefits of narrower keys?	4.55 (±3.33)	3.11 (±2.72)	5.02 (±3.41)	0.084

## Discussion

UNT is one of only a few NASM schools offering ESPKs in the USA. This might be the reason behind the high overall awareness and knowledge level. Although a significant number of subjects have already heard and experienced ESPKs (DS 6.0® size keyboards), the degree of further interest was quite low, and the positive attitude toward ESPKs was slightly higher than a moderate level. Their initial negative experience of ESPKs may influence their further interest. Wristen found that transitioning to ESPKs (DS 5.5® size) comfortably requires an adjustment time and over the course of 7 trials on ESPKs, pianists became much more comfortable using them.<sup>41</sup> In addition, several competitors in the Dallas International Piano Competition have competed on the DS 6.0® size after only a day or so of practice, and one of these competitors went on to win 3<sup>rd</sup> prize.

Although UNT offers ESPKs for their students in both a practice room and a performance hall, 8% of subjects had not heard about them at all, and 22.7% of participants had not even tried them. Awareness needs to be increased by providing specific information about ESPKs including their availability, the advantages regarding reducing pain and injuries, and the necessity of allowing time to adjust between two different sized keyboards so that ESPKs can be used efficiently.

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<sup>41</sup> Wristen, 9-16.

Additional research is needed to better understand prejudices and obstacles. Although using narrower keys may reduce hand tension, pain, and injury among small-handed pianists, substantial numbers of people may not know their advantages or even their existence. This study was limited to only one school so the results cannot be generalized to other schools or any other populations. Extended research is needed to assess these perceptions in locations where these options are unavailable. It could be helpful to raise awareness, and to help performing arts medicine professionals develop intervention strategies for addressing musculoskeletal health among pianists and student musicians. For this reason, an additional survey was designed and conducted throughout the USA. It will be discussed in the next chapter.

## CHAPTER 3

### SURVEY 2: AWARENESS AND ATTITUDE OF PROFESSIONAL KEYBOARD PLAYERS TOWARD ESPK AT MULTIPLE SCHOOLS OF MUSIC IN THE USA

#### Method

##### Subjects

Following screenings for incomplete submissions, a final cohort of 179 subjects were analyzed. Participants were 130 professors working in schools of music, 44 classical piano major students and five unclarified subjects. They were between 18 to 78 years of age, and the number of years of playing the piano ranged from 5 to 70 years. The total number of participants per question may vary (less than 179) because participants were allowed to skip any questions to which they did not want to reply.

##### Procedures

Following development, pilot testing, and IRB approval of a survey-based data collection methodology, e-mails were sent to approximately 476 professors in 169 schools of music asking faculty to participate and to forward the survey to their piano major students. Two follow-up reminders encouraged their participation. The survey was active for sixty-nine days from July to September of 2017.

##### Questionnaire

The questionnaire was developed using Qualtrics survey software.<sup>42</sup> It consisted of; 1) 7 questions of demographics, 2) 4 questions of hand size and desired hand size, 3) 4 questions of

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<sup>42</sup> Qualtrics online survey tool, accessed April, 2017, <https://unt.az1.qualtrics.com/ControlPanel/>.

hand pain and hand-related problems, 4) 5 of awareness and use of ESPK, 5) 6 general questions about knowledge of hand size, pain, history of piano sizes, and literature, and 6) 6 of subjects' interest and attitude toward ESPKs. Response options included multiple choices, yes-no, and short answer (numbers). Response options also included VAS scales that required participants click or scroll the cursor to reflect their responses. Depending on the question, results reported on VAS ranged from; *not at all* (0) to *very much larger* (100), *never* (0) to *always* (100), *not at all* (0) to *completely* (100), *do not agree* (0) to *totally agree* (100), *not at all* (0) to *very interested* (100), *not at all* (0) to *very much* (100), and *not at all* (0) to *very interested* (100). When finished, the survey provided a short educational intervention designed to raise awareness and increase knowledge regarding questions presented in section 5. After the intervention, questions about interest and attitude were asked to gauge the influence of the educational intervention. Finally, an open-ended question examined respondents' opinions about factors that may limit the adoption and endorsement of ESPKs.

## Data Analysis

Parametric and non-parametric statistics were deployed to provide descriptive and comparative indexes. Questions about hand size and pain were compared across gender, and awareness and knowledge were compared across faculty and students. Attitudes were compared between people who had known about ESPKs and those who had not. Narrative responses to the open-ended "opinion" question were used to provide insights regarding pianists' opinions towards the use of ESPKs. All Statistical analyses were performed using IBM SPSS statistics version 24.

## Results

### Quantitative Data

#### *Demographics*

Demographic data, as shown in Table 11, reflects a subject population of highly educated and experienced pianists. Eighty-two of male and ninety-two of female participants showed a similar gender ratio. The highest percentage (n=118, 49.8%) of participants identified as Caucasian, followed by Asian (n=41, 17.3%). The number of faculty members (n=130) was much higher than the number of students (n=44). There was no significant difference across gender for years playing piano and teaching load per week.

*Table 11. Demographics*

Variables	Total	Male	Female	Test	Sig.	
Gender	174	82	92			
Age (SD)	44.45 (±17.14)	44.98 (±16.37)	43.98 (±17.87)	<i>t</i>	0.703	
Ethnicity	Caucasian	118	61	57	$X^2$	0.039*
	Asian	41	11	30		
	Hispanic	5	3	2		
	Others	7	4	3		
Final Degree	High school	7	4	3	$X^2$	0.173
	Bachelor	6	2	4		
	Master	57	21	36		
	DMA	94	52	42		
	Others	9	3	6		
Avg. Years playing piano (SD)	39.07 (±16.06)	38.46 (±15.59)	39.61 (±16.53)	<i>t</i>	0.640	
Number of music faculty	130	67	63			
Avg. Teaching load per week(SD)	17.34 (±9.35)	17.97 (±9.75)	16.67 (±8.93)	<i>t</i>	0.160	
Number of music major students	44	16	28			

\*significant at  $p < 0.05$ .

## Hand Span

As shown in Table 12, when asked about hand span, a majority of males reported that they can reach up to the interval of a 10<sup>th</sup> (39.5%) or a 11<sup>th</sup> (44.4%), while most of the females can reach up to a 9<sup>th</sup> (51.2%) or a 10<sup>th</sup> (39.3%). About 52% of male pianists can reach more than a 10<sup>th</sup>, but only 6% of female pianists can reach more than a 10<sup>th</sup>. None of the female pianists can reach up to the interval of a 12<sup>th</sup>, compared to 7.9% of male pianists. It is confirmed that hand span of males is bigger than females. Based on the classification of the small hands (less than 8.5 inches) by Boyle,<sup>43</sup> 54.2% of female pianists have small hands. However, only 7.5% of male pianists belong to this small hand group.

Table 12. Description of maximum hand span

Description of Hand Span	Total N (%)	Male N (% within Gender)	Female N (% within Gender)
I can play the interval of a 7 <sup>th</sup> with my thumb and 5 <sup>th</sup> finger without depressing neighboring keys, and reach up to an octave. (About 6.7 inches/17cm)	3 (1.8%)	0 (0%)	3 (3.6%)
I can play the interval of an octave with my thumb and 5 <sup>th</sup> finger without depressing neighboring keys, and reach up to a 9 <sup>th</sup> . (About 7.6 inches/ 19.3 cm)	50 (30.3%)	6 (7.5%)	42 (50.6%)
I can play the interval of a 9 <sup>th</sup> with my thumb and 5 <sup>th</sup> finger without depressing neighboring keys, and reach up to a 10 <sup>th</sup> . (About 8.5 inches/ 21.6 cm)	65 (39.4%)	32 (40%)	33 (39.8%)
I can play the interval of a 10 <sup>th</sup> with my thumb and 5 <sup>th</sup> finger without depressing neighboring keys, and reach up to an 11 <sup>th</sup> . (About 9.4 inches/ 23.9cm)	41 (24.8%)	36 (45%)	5 (6%)
I can play the interval of an 11 <sup>th</sup> with my thumb and 5 <sup>th</sup> finger without depressing neighboring keys, and reach up to a 12 <sup>th</sup> . (About 10.3 inches/ 26.2cm)	6 (3.6%)	6 (7.5%)	0 (0%)
Test: $X^2 = 0.000$ ***			

\*\*\*significant at  $p < 0.001$ .

<sup>43</sup> Boyle, 2015

A yes-no question to find out the 2-5 span of hand was asked; while sustaining an octave built on C with my right hand, my index finger can depress the E flat without tilting my hand to the side or depressing neighboring keys. Since this is a critical hand span to play large chords or arpeggios, the 2-5 span of 6 inches is needed and 2-5 span of less than 6 inches was considered to assess small hands as well.<sup>44</sup> Among 165 subjects who replied to this question, 9 males and 19 females said that they could not depress E flat key while sustaining an octave built on C without tilting or depressing other keys (Table 13).

Although twelve participants (7.3%) have more than 8.5 inches of 1-5 span and reach up to a 10<sup>th</sup> or more, their 2-5 span was less than 6 inches (Table 14). Including these people increases the number of the small hands group.

*Table 13. The 2-5 span of hand*

While sustaining an octave built on C with my right hand, my index finger can depress the E flat without tilting my hand to the side or depressing neighboring keys.	Total N of subjects (%)	Male N of subjects (% within Gender)	Female N of subjects (% within Gender)
Yes	137 (83%)	72 (88.9%)	65 (77.4%)
No	28 (11.8%)	9 (11.1%)	19 (22.6%)
Test: $X = 0.049^*$			

\*significant at  $p < 0.05$ .

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<sup>44</sup> Boyle, 2015.

Table 14. Distribution of 2-5 span comparing with 1-5 span

Description of Hand Span	While sustaining an octave built on C with my right hand, my index finger can depress the E flat without tilting my hand to the side or depressing neighboring keys. (More than 6 inches of 2-5 span)		
	Total N of subjects (%)	Yes N of subjects (%)	No N of subjects (%)
I can play the interval of a 7th with my thumb and 5th finger without depressing neighboring keys, and reach up to an octave. (Total n= 3, 1.3%)	3 (1.8%)	1 (0.6%)	2 (1.2%)
I can play the interval of an octave with my thumb and 5th finger without depressing neighboring keys, and reach up to a 9th (Total n=50, 21.1%)	50 (30.3%)	35 (21.3%)	14 (8.5%)
I can play the interval of a 9th with my thumb and 5th finger without depressing neighboring keys, and reach up to a 10 <sup>th</sup> . (Total n=65, 27.4%)	65 (39.4%)	55 (33.5)	10 (6.1%)
I can play the interval of a 10th with my thumb and 5th finger without depressing neighboring keys, and reach up to an 11th. (Total n=41, 17.3%)	41 (24.8%)	39 (23.8%)	2 (1.2%)
I can play the interval of an 11th with my thumb and 5th finger without depressing neighboring keys, and reach up to a 12 <sup>th</sup> . (Total n=6, 2.6%)	6 (3.6%)	6 (3.7%)	0 (0%)
Total Number	136 (100%)	136 (82.9%)	28 (17.1%)
Test: $X = 0.004$ **			

\*\*significant at  $p < 0.01$

### *Desired Hand Size*

Fifty-six percent of females reported a desire to have larger hands, compared to 28.4% of males wishing to have larger hands (Table 15). Females desired larger hands more than males.

The smaller the hands of the pianists, the more likely they want to desire bigger hands.



Table 15. Desired hand size

Q. Do you wish to have a different hand size?	Total N of subjects (%)	Male N of subjects (% within Gender) Total=80	Female N of subjects (% within Gender) Total=84
Yes, larger hands	71 (42.8%)	23 (28.4%)	47 (56.5%)
No, I am satisfied with the size of my hands	95 (57.2%)	58 (71.6%)	37 (43.5%)
Test: $X = 0.000$ ***			

\*\*\*significant at  $p < 0.001$ .

*Tension, Pain and Uncomfortable Feeling*

One hundred and seven participants (64.8%) reported they had experienced tension, pain, and uncomfortable feeling in their fingers, hands, or wrists when they practice the piano (Table 16).

Table 16. Experience of tension, pain, uncomfortable feeling

Variable		Total N of subjects (%)	Male N of subjects (%)	Female N of subjects (%)
Have you ever had tension, pain and uncomfortable feeling in your fingers, hands, wrists when you practice piano?	Yes	107 (64.8%)	49 (61.3%)	58 (68.2%)
	No	58 (35.2%)	31 (38.8%)	27 (31.8%)

Participants marked the frequency of tension, pain, and uncomfortable feeling on the VAS from 0 (Never) to 100 (Always). Female participants experience these symptoms more often than the male participants during practice (Table 17).

Table 17. The frequency of tension, pain, uncomfortable feeling

	Total Mean(SD)	Male Mean (SD) Total n=46	Female Mean (SD) Total n=57	t -Test
How often do you have that tension, pain, uncomfortable feeling during the practice?	22.99 (±22.51)	15.85 (±17.96)	28.75 (±24.25)	0.003 **

\*\*significant at p<0.01.

*Relationship between Repertoire, Problematic Passages, and Hand Size*

Eighty-seven percent of female participants (n=74) have experienced problematic passages due to hand size, while a 58 % of male participants (n=45) have experienced this problem (Figure 15). A great number of participants have experienced problematic passages due to hand size.

Table 18. Difficulty of playing certain passages

Q. Have you ever had a problem playing certain chords or passages because of your hand size?	Total N of subjects (%)	Male N of subjects (% within Gender)	Female N of subjects (% within Gender)
Yes	119 (73.5%)	45 (58%)	74 (87%)
No	43 (26.5%)	32 (42%)	11 (13%)
Test: X = 0.000 ***			

\*\*\*significant at p<0.001.

Females agreed that hand size has an influence on choosing repertoire significantly more than males on Table 19.

Table 19. Hand size influence on the choice of repertoire

	Total Mean (SD)	Male Mean (SD) Total n=73	Female Mean (SD) Total n=82	t -Test
Do you think hand size has an influence on choosing repertoire?	22.99 (±22.51)	48.23 (±33.73)	61.09 (±34.89)	0.021 *

\*significant at p<0.05.

*Awareness/Knowledge*

Table 20 shows the awareness and knowledge of participants. Although a significant number of participants (71%) knew about availability of ESPKs, only 33.7% of participants had played on ESPKs (Table 21). Awareness about the diffusion of ESPKs is lower than 50 in both student and faculty groups. However, faculty showed significantly higher levels of knowledge about the correlation between pain and hand size, and historical music composed on the narrower keyboards than students. Both groups highly agreed that using a narrower piano can reduce hand tension, pain and injury.

*Table 20. Awareness and knowledge*

Variables	Total mean (SD) N	Students Mean (SD) N	Faculties Mean (SD) N	t-test
Some music departments offer pianos with narrower keys to their students	47.28 (±39.29) N=135	48.35 (±39.28) N=34	46.50 (±39.52) N=102	0.855
Some competitions allow using pianos with narrower keys along with modern pianos for their competitors.	42.07(±38.75) N=111	44.13 (±36.93) N=30	41.44 (±39.37) N=82	0.727
Men have larger hand spans than women in general.	73.58 (±28.38) N=148	74.05 (±24.63) N=37	73.31 (±29.52) N=112	0.899
Hand size is related to race and ethnicity.	40.25 (±33.15) N=122	40.45 (±32.36) N=31	40.46 (±33.51) N=92	0.968
Hand size has an influence on the pain of fingers, wrists or hands of pianists.	53.45 (±33.82) N= 144	44.30 (±29.66) N=37	56.41 (±34.61) N=108	0.041*
Piano key width (different from numbers of keys) has been continually changed from its invented time.	64.18 (±33.15) N=148	54.87 (±33.79) N=38	67.32 (±32.32) N=111	0.051
Most music composed between 1750 and 1850 (Mozart 1756-1781, Beethoven 1770-1827, Schubert 1797-1828, Chopin 1810-1869, Liszt 1811-1886 included) was composed on instruments with narrower keyboards.	67.14 (±32.09) N=148	56.08 (±37.25) N=36	70.83 (±29.66) N=111	0.033*
Using narrower piano keyboards for pianists with a small hand span can reduce hand tension, pain, and injury.	74.09 (±29.93) N=147	64.53 (±33.60) N=36	76.96 (±28.08) N=112	0.046*

\*significant at p< 0.05.

Table 21. Experiencing ESPKs

	Yes Number of subjects (%)	No Number of subjects (%)
Did you know piano keyboards with narrower keys are available for pianists with a small hand span to play?	116 (71.2%)	47 (28.8%)
Have you ever seen a piano keyboard with narrower keys?	70 (42.9%)	93 (57.1%)
Have you ever tried a piano keyboard with narrower keys?	55 (33.7%)	108 (66.3%)

### Interest

Table 22 shows the mean of participants' interest about narrower keyboards. Subjects reported medium levels of interest in learning about a narrower keyboard. However, their interest level regarding historical changes of key width was higher.

Table 22. Interest in narrower keyboards

	Total Mean (SD)	Students Mean (SD) n=34	Faculties Mean (SD) n=104	<i>t</i> -Test
Are you interested in learning more about narrower piano keyboards options that are available today?	56.61 (±34.87)	45.59 (±33.33) n=34	60.22 (±34.76) n=104	0.033*
Are you interested in learning more about the changes to the historical keyboard key widths?	67.60 (±33.06)	63.40 (±32.67) n=35	68.99 (±33.23) n=106	0.388
Are you interested in learning more about the benefits of playing narrower piano keyboards?	58.26 (±35.66)	49.97 (±38.46) n=33	60.83 (±34.52) n=106	0.127

\*significant at  $p < 0.05$ .

### Attitude

As shown in Table 23, the subjects who reported prior awareness of ergonomically modified keyboards have a significantly positive attitude toward ESPKs. They were more likely

to report that students should know about this option that schools of music should offer this option, and less likely to report that this option is a form of cheating.

Table 23. Attitude toward ESPKs

Variables	Total Mean (SD)	People who have known about narrower keyboards Mean (SD)	People who have not known about narrower keyboards Mean (SD)	t-Test
Do you think piano students should know about narrower piano keyboards?	73.82 ( $\pm$ 30.80) N=148	78.67 ( $\pm$ 29.16) N=106	61.57 ( $\pm$ 31.79) N=42	0.004**
Do you think music departments at colleges or universities should have narrower piano keyboards for their students?	60.01 ( $\pm$ 33.72) N=140	67.57 ( $\pm$ 31.24) N=102	39.71 ( $\pm$ 32.04) N=38	0.000***
Do you think that performing narrower keyboard is a form of “cheating?”	25.05 ( $\pm$ 32.66) N=107	18.65 ( $\pm$ 28.10) N=75	40.03 ( $\pm$ 37.83) N=32	0.006**

\*\*significant at  $p < 0.01$ ; \*\*\* significant at  $p < 0.001$ .

*Comparison of Pre-Post Questionnaire*

Table 24 shows the difference between pre- and post-questions, and there are no significant changes in responses to post-questions that followed the education intervention.

Table 24. Comparison of questions between pre-post Educational Intervention (EI)

	Student		Faculty		Total	
	Pre- EI Mean (SD)	Post-EI Mean (SD)	Pre- EI Mean (SD)	Post- EI Mean (SD)	Pre- EI Mean (SD)	Post- EI Mean (SD)
Do you think that performing on narrower keyboards is a form of “cheating?”	25.13 (34.26)	24.54 (29.35)	25.01 (32.21)	23.42 (33.23)	25.05 (32.66)	23.70 (32.17)
Do you think music departments at colleges or universities should have ESPK for their students?	60.68 (36.37)	63.68 (29.17)	59.79 (33.00)	63.41 (33.92)	60.00 (33.72)	63.47 (32.81)
Do you think piano students should know about ESPK?	71.71 (32.00)	68.82 (32.17)	74.45 (30.56)	71.39 (32.50)	73.82 (30.81)	70.80 (32.33)

(table continues)

	Student		Faculty		Total	
	Pre- EI Mean (SD)	Post-EI Mean (SD)	Pre- EI Mean (SD)	Post- EI Mean (SD)	Pre- EI Mean (SD)	Post- EI Mean (SD)
Are you interested in learning more about ESPK options that are available today?	45.59 (33.33)	50.32 (34.04)	60.22 (34.76)	61.26 (34.33)	56.62 (34.87)	58.73 (34.44)

### Qualitative Data

Qualitative data was collected through the last question; “What are the possible obstacles or prejudices in giving options of narrower piano keyboards to pianists, students, and to the public?” One hundred twenty-four subjects replied to this question and offered multiple reasons. Among the answers, the cost was the most frequent response (n=34) and followed by availability (n=32). Piano quality (n=10) and spatial confusion and difficulty with adjustment (n=8) were also reported. Other opinions are difficulty of breaking tradition (n=6), cheating (n=6), limited space (n=5), and impartiality (n=4).

### *Cost*

Among the answers, the cost was considered the primary barrier adapting ESPKs. A total thirty-four participants mentioned it, and they used the words, budget, cost, financing, expense, affordable, economic factors, funds, and price (Table 25). Many professors expressed their concerns about the financial problems of the schools.

### *Availability*

The second most frequent answer was availability, and 32 subjects stated it as a major obstacle. A substantial number of subjects mentioned of lack of availability in concert venues

and competition. They worried about practicing on ESPKs but performing on a standard keyboard. For this reason, one even mentioned that practicing on a narrower keyboard is “useless” (Table 26).

*Table 25. Comments regarding cost*

- Great colleges and universities do not have the funds to invest in additional pianos with narrower keyboards. They are having a very difficult time finding the funds to hire the personnel and buy the materials to maintain/restore the standard grand pianos they currently own.
- Performance venues/schools do not have a budget to get these special instruments.
- Acoustic pianos are already expensive. Having a piano with narrower keys and good quality of sound will be a significant expense.
- I'm not sure that is a cost-effective option for pianists.
- Cost of adding a couple of practice rooms and performance spaces. You can't have two performance-quality pianos in every room. Every pianist needs to be able to play on the regular formatted piano.
- Our institution has a 7/8 keyboard, but it is not removable, so we have to pay to move the piano every time a student needs to use it for a performance. Over time, the costs can be budgeted for.
- I can't afford one.
- It's an option for rich amateurs, but for pros... difficult. I understand Joseph Hoffman shipped his instrument around. I don't think that really works today.

*Table 26. Comments regarding availability*

- We don't always get a choice.
- Pianists cannot carry them anywhere they want.
- There are often situations where playing on a standard keyboard is the only options.
- We had one 7/8 keyboard at our institution. The problem is that pianists cannot depend on having access to a narrow keyboard at other venues.
- Only one very important one, as I see it: since they are not universally available, pianists will still be in situations where they have to perform on standard-sized keyboards.
- If the venue does not have the narrow keyboard available, artists will need to bring in the special instrument.
- It isn't feasible for many students to transport their own pianos with them and many competitions/schools do not or are not able to provide narrow keyboards to competitors/auditioners, thus rendering it almost useless to practice on a narrow keyboard unless you have the resources to transport your own piano.

Beyond these responses, subjects' fear of confusion with differently sized keyboards on stage was revealed. Therefore, this second most frequent answer, availability, is very closely intertwined with the fourth most frequent response, 'spatial confusion and difficulty with adjustment.'

### *Quality of Pianos*

Among participants of the last open question, 10 subjects were concerned about the quality of ESPKs. They pointed out since the manufacture of ESPKs is not widely known, the quality of sound would not be guaranteed. They expected that if major manufacturers produce narrower keyboards, people's perception would change (Table 27).

*Table 27. Comments regarding quality of ESPKs*

- Bad quality pianos since the best makers probably won't make narrow key pianos.
- Having a piano with narrower keys AND good quality of sound will be a significant expense.
- It's not the same instrument. Could it possible change the resonance, acoustics, and action?
- Perhaps people think it won't be easy to change keyboards on a piano so easily, fears about the way the sound could possibly change with the hammers not being centered.
- The companies who manufacture narrower keyboards are not well-known: not sure if their tone-quality will match that of a Steinway or other established brands.
- Until the best manufacturers offer this option, ensuring that quality instruments are using the new keyboard, I will continue to train my students to use the current keyboard.
- Encouraging construction of smaller keyboard actions by major piano manufacturers (Steinway, Yamaha/Bösendorfer, and Kawai) to reduce the perception of lesser quality in third-party actions.

### *Spatial Confusion and Difficulty with Adjustment*

Eighteen subjects responded that spatial confusion and difficulty of adjustment between two different sized keyboards were a major obstacle to accept ESPKs. Many people assumed that there would be confusion in muscle memory and kinesthetic sense. Some participants who had tried narrower keyboards shared their negative experience of confusion, and one subject stated



playing on the narrower keyboards would be “just one additional challenge to overcome at a ‘new’ instrument” (Table 28).

*Table 28.* Comments regarding spatial confusion and difficulty with adjustment

- What happens if in the academy a pianist gets used to playing a smaller keyboard and then performs on one that is standard size?
- It would be had to adjust from the regular size I am used to.
- Relearning muscle memory of basic technique.
- A lot of playing the piano is gestures, hand shifts, the narrower keys will affect the distance of the shifts, and how the fingers feel on the keys.
- The consistency of distance between notes is a major concern. Especially when faced with large leaps.
- I think it is hard to switch to a narrower piano keyboard at a certain age after many movements are already automatic.
- Learning on a smaller piano will also alter the hand and brain perception of interval size, from seconds to the largest interval possible; this could also present challenges when adjusting to a regulation length instrument.
- I actually have played instruments that have narrower keys and also different tempered tuning and I found it extremely frustrating.
- I found that my hands have learned the kinesthetic ‘feel’ of the standard width keys; that is, my hands know the spatial ‘feel’ of certain chords or intervals. When I tried the narrower keys, my spatial sense of the keyboard was dramatically confused.

### *Other Opinions*

People often felt uneasy about breaking standard conventions. Six subjects pointed out the difficulty of breaking tradition and fixed ideas as the main obstacle. Since the modern piano has been used for such long time, some people assumed that pianists would be reluctant to accept this new change. One participant was even worried about being “ostracized” by choosing some abnormal piano keyboards (Table 29).

Some of the participants (n=6) mentioned that using ESPKs might be treated as cheating. They did not use “I” but instead used “some” would think of it as cheating (Table 30).

*Table 29. Comments of difficulty of breaking tradition/ fixed idea*

- I think that since we have had the modern grand for so many decades now, and so many great pianists have risen to prominence in spite of their hand size, it is difficult for people to give up the traditional idea of what a piano should be.
- Tradition- Other small hands pianists from the past were able to play.
- Perhaps only the history and tradition of piano and/or keyboard actions would somewhat be involved in a someone's perception and attitude.
- Anyone who chooses to do something outside of the norm is often ostracized.
- Wrong perception of the history of piano keyboards.
- The rigidity of thinking.

*Table 30. Comments about cheating*

- Some may feel it is cheating.
- I suspect that some people would consider it 'cheating' if contenders in national and int'l. competitions were allowed to play on pianos with narrower keys. I do not... but I think some music competition directors, teachers, and performers might.
- In competitions, the conditions would not be uniform, and thus the playing field would not be level. This could be viewed as cheating by some.

Limited space was pointed out as an obstacle by five participants (Table 31). Pianists may believe that they need more space for another full-size grand piano. This reaction might be generated by a lack of the technical understanding of retrofitted, removable ESPKs in existing grand pianos.

*Table 31. Comments of limited space*

- Pianos take up a lot of space- hard to invest in multiple sizes.
- Additional storage facilities for the alternate piano actions, as well as educating technicians to maintain them to the same standards as traditional actions.
- Space issue.
- You can't have two performance-quality pianos in every room.
- Principal obstacles are cost and space.

Four of participants were concerned about the impartiality of using ESPKs (Table 32).

They pointed that the narrower piano keyboards for small handed pianists could be a reverse discrimination in the competitions against others.

*Table 32. Comments of impartiality*

- It is not fair for some people to use a narrower piano in the competition.
- Also, hypothetically, if pianists with big hands have the option to play on narrower pianos, it can be argued that that would give an unfair disadvantage to pianists with small hands.
- Much of the music is written to be difficult and much of the difficulty lies in the ability to jump, reach etc. Making this easier would create difficulties in judging. If making smaller keyboards are going to be used in a competition then everyone ought to be playing on the same ratio of key width to hand size and make it completely fair and exact.

Other than these prejudices and barriers, people shared their thoughts and critiques regarding this issue (Table 33). Some participants emphasized proper education for small hands to manipulate technique regardless of hand or keyboard size. One claimed that giving small piano options may remove the opportunity to learn successful technical solutions and musicianship from their students. People who had slightly negative viewpoints highlighted the importance of learning flexibility of their hands at the piano and choosing appropriate repertoire. They emphasized that pianists need to be able to perform on the standard piano.

*Table 33. Critiques regarding using ESPKs*

- I believe that the successful and pain-free approach can be learned properly at a young age by a person with any size of hands. The troubles begin when the hand is used incorrectly, and it can happen, regardless of the span and size. By introducing the options of altered-size keyboards, teachers take responsibility for misleading pianists into thinking that their technique or, (worse), musicianship will improve, as a result. On a contrary, finding solutions to small hands is a part of our profession that should not be feared. There is no need to cover the real problem with temporary adjustments.
- If someone wants smaller keys then use them. It does have a bearing on the technical mastery or its appearance.
- Piano keyboards are a standard size and regardless of the options available, a pianist needs to have the ability to perform their best on a standard instrument. Most pianists accept engagements without the knowledge or the ability to choose their own instrument, so even if they learn or practice on variable size keyboard it is important that they can perform on a standard during their career.

*(table continues)*

- Playing a narrower keyboard must not become a substitute for playing in a healthy manner. A person with small hands could conceivably play with tension, twists, and bad alignment on a narrower keyboard and feel less discomfort. Perhaps feeling discomfort or pain on a traditional keyboard would motivate pianists and teachers to change the fundamental manner of playing instead of just the conditions.
- I don't think it creates a level playing field. Pianists who have smaller hand spans should learn to choose their repertoire more carefully, AND learn principles of flexibility in playing.
- You are assuming that piano technique is identical. There are many examples of pianists of the highest levels with small hands. The issue of hand size is just one of many variables such as flexibility through the entire physical structure used to play. This is a non-issue.
- Pianists need to know how to play healthily on what is currently available. I agree that narrower keyboard can be easier, but it is not impossible for students with smaller hands to play well and healthily on modern size keyboards, even if in some extreme cases it limits their repertoire.

Meanwhile, there were several participants showing positive attitudes toward ESPKs (Table 34). They understood small-handed pianists suffering from pain, technical difficulties, and the limits of repertoire. One participant mentioned a compromise plan that he/she can practice and learn repertoire on an ESPK, but performing and recording on a standard piano. It is worth noticing that some of the participants showing positive opinions on this question had already experienced ESPKs and their advantages.

*Table 34. Positive opinions about using ESPKs*

- I don't see any obstacles.
- I think it would be esp. appropriate for young pianists whose hands haven't developed yet. We all know great pianists with small hands, i.e. Alicia De LaRocca, who was not handicapped by their small hands and found ways to get around issues involving them. But I don't think she played much Rachmaninoff. With my span of a 10<sup>th</sup>, Rachmaninoff is still difficult for me, as he had huge hands, so I understand what people with small hands go through with other composers. I do think the strain of overstretching is an important issue for small hands and could be addressed by having these keyboards available in universities.
- I am concerned about practicing or learning repertoire on a narrow piano—but then having to travel and perform/record on a 'normal' piano.
- I think attitudes will change. Having a smaller keyboard has made a huge difference for many of our piano students. I play Rachmaninov and Scriabin on it for fun even though my hands are fairly large (especially for a female pianist)

## Discussion

Perhaps the most important finding from this study is that pianists who are aware of ESPKs report significantly higher positive attitude compared to those have not known about ESPKs. This suggests that raising awareness is immensely important. However, the study does have limitations. The number of professors among the participants was much higher than the number of students. Since this survey was conducted between summer break and the beginning of the fall semester, it seems that the participating degree of students was quite low. If the number of two groups had been similar, it would have been possible to compare these various questions reliably. In addition, hand span data reported in this study may not be representative of pianists at large. One possibility is that the inclusion of professors in this study skews the results toward larger sizes and is reflective of their overall success as pianists.

The interest in the changes of historical piano size was quite high. If pianists know that the key size has not always been standard, perhaps they might be willing to consider ESPKs. There are no notable changes between pre- and post-questions. Pre-questions were presented after participants already had an opportunity to learn enough about ESPKs. For this reason, these might not have been an accurate assessment of their previous attitude, and the post- questions were not sufficient to compare the results. If the questions were asked in the very first stage of the questionnaire, it might have been possible to see some changes in their attitude on the post questions at the end.

Price, space, and piano quality were the most common anticipated barriers to responses to using this piano. These responses could be changed if pianists were provided with proper information about installation. Since ergonomically scaled keyboards can be retrofitted to existing high quality grand pianos such as Steinway and Sons or Yamaha, and removable after

use, the sound quality does not dramatically change. Instead of purchasing the entire piano, only a keyboard needs to be purchased. Therefore, cost and space may not be as big of an obstacle as expected. More technical education is needed to reduce these prejudices.

While the first survey assessed awareness and attitude of pianists in a school where ESPKs are offered, this second survey included participants from schools where ESPKs were not yet available. In addition, the methodology used in the second survey included open-ended responses options in order to collect qualitative data. This provided deeper insight into the attitudes and beliefs of pianists.

## CHAPTER 4

### DISCUSSION

Change in health-related behavior or attitude does not occur overnight. It can take time to change and gradually through various stages. According to one health behavior theory, the Transtheoretical Model (TTM), the process of behavior change is explained in 6 stages. These stages are: precontemplation, contemplation, preparation, action, maintenance and termination. During the precontemplation stage, people are totally unaware about the issue, and not ready to change. They do not intend to take any action (Pros<Cons). During the contemplation stage, people are intending to start action in the near future. They are measuring cons and pros (Pros=Cons). The preparation stage begins when people are ready to take action (Pros>Cons). Next is the action stage when people have taken some action to change their behavior, and they intend to keep the changes. The maintenance stage is when people have maintained their healthier behavior, and try to prevent returning to previous stages. When they reach the termination stage, people have no desire to return to their unhealthy behaviors.

In the context of healthy playing, the stages of behavior change may be conceptualized in Table 35.

*Table 35. The stages of behavior change in the context of healthy playing*

Precontemplation stage	People in this stage think there is absolutely no injury to themselves, so they are not interested in injury prevention. They do not take it seriously even if they feel tension, discomfort and pain, since they think it is unavoidable. They think injury is caused by a lack of capacity or technique rather than thinking of injuries as an accident caused by ignoring these symptoms.
Contemplation stage	People have heard about pianists' injuries, and that tension or discomfort can lead to injury. They know that tension and pain should not be ignored.

*(table continues)*

Preparation stage	At this stage, pianists are very interested in healthy playing. When they feel tension or pain, they take a moment to rest and try to find out the cause and a solution.
Action stage	People at this stage try to stop playing immediately when they feel tension or pain, and they attempt various ways to avoid this discomfort such as changing practice method, posture or wrong habits. They may also seek advice from acquaintances or experts. When choosing repertoire, they avoid music that causes many tension and pain and choose music that is suitable for them.
Maintenance stage	People understand the condition and limitations of their hands and body. They are actively using injury prevention techniques to correct their bad posture and habits that produce tension or pain. They actively accept the help of specialists. They do not choose repertoire that could cause tension or injury.
Termination stage	People in this stage continue healthy practices. They do not go back to previous bad habits and posture that cause discomfort.

It seems that there is no need to discuss the later 3 stages from action to termination here, as positive changes in behavior are already occurring in these stages. However, it is necessary to consider how to approach the people in the previous three stages.

During the precontemplation stage, people are unlikely to use ESPKs even if they are offered. They believe using ESPKs is a waste of time because they believe they are not at risk. Rather than letting people at this stage know how to reduce or prevent injuries, there is a need to inform them that injuries can happen to anyone, including them. Showing the various cases and statistics of the injuries occurring to pianists could be one way to raise their attention.

People in the contemplation stage have heard about playing related injuries. They know such injuries may happen to themselves. They may have colleagues who have experienced tension, discomfort or pain around them, or they may have had such experiences. People at this stage tend to compare the pros and cons of behavior changes and determine their future behavior based on the result of these comparisons. Therefore, it is desirable to provide as many opportunities as possible to access information about playing related injuries such as injury



prevention technique, appropriate repertoire selection methods, and ESPKs as an alternative. If the merits of change in behavior are highlighted by providing this information, people are very likely to proceed to the next stage. Schools should not only provide such education, but also introduce these sources or organizations to help people get the information they need.

People at the preparation stage are ready to move into positive action. These people are actively trying to figure out how to prevent pain and to try these strategies. If these people are provided ESPKs, they will be able to experience the advantages by using the piano directly. The school should provide specific information such as the characteristics of ESPKs, how the piano can be obtained (schools, competitions, piano manufactures, etc.), and the adjustment time. In addition, it might be helpful to interact with people who actually use ESPKs and hear their experiences.

Informing about PRMD and diffusing ESPKs should proceed sequentially. As shown by the results of the survey at UNT, providing ESPKs without any education can increase the possibility that people will not use the piano at all, or will lose further interest even if they have tried one. The responses to the last question regarding barriers and prejudices of the second survey show that many of their prejudices stem from a lack of appropriate information about ESPKs. The finding of this study does not support the hypothesis that raising awareness changes people's perception toward ESPKs. The education intervention did not significantly change people's attitude toward ESPKs. However, it is worth noticing the importance of proper education. Without knowing general facts about ESPKs such as installation processes, advantages and adjustment time, people may easily overestimate the cons of ESPKs.

Because of this, it is urgently necessary to educate people about injury prevention and ESPKs specifically in advance of dissemination.

## CHAPTER 5

### CONCLUSION

Everyone agrees that it is not a trivial matter when pianists feel tension or pain while practicing, but in reality, it is difficult to take appropriate action whenever they have that problem. Therefore, it is necessary to prevent and reduce such injuries before pianists encounter irreversible problems. Researchers who have studied the hands of pianists found that small hands is one of the significant risk factors for pianists. They also pointed out that many pianists were in the category of small hands. ESPKs have been developed to reduce and prevent their pain, tension, and potential injuries, and they have been used for over two decades. However, dissemination of ESPKs is still insufficient. Two surveys were designed to assess the perceptions and attitudes toward ESPKs and to raise awareness of them. The first survey was conducted to understand perceptions and attitudes of 49 pianists at the University of North Texas, which provides ESPKs for their students. As in previous hand studies, it was found that females' hands were much smaller than males' hands, and 73% of participants wanted to have larger hands. The desire for larger hand size was much more prevalent among the people who estimated their hands small. Since UNT is one of few schools that have ESPKs for their students, the result showed a high awareness and a relatively positive attitude toward ESPKs, but further interest seemed to be low. Their first attempt on ESPKs without sufficient education seemed to lead to a negative perception, and it caused the loss of their further attention. The second survey was extended from the first one, and conducted throughout music schools in the United States. One hundred forty-four piano professors and 35 piano students participated. It confirmed the huge diversity of hand size across gender and ethnicities. A substantial portion of pianists, 54.2% of female and 7.5% of male pianists are in the small hand group based on Boyle's classification

(less than 8.5 inches).<sup>45</sup> About 65% of participants had experienced pain and tension during their practice, and the frequency of pain and tension was much higher among the female pianists than male pianists. Subjects' awareness about ESPKs were slightly lower than a moderate level. However, their general knowledge about the diversity of hand size, music composed on narrower keyboards between 1784 and 1850, and the relation between pain and hand size were slightly higher. Subjects who reported prior awareness of ergonomically modified keyboards show significantly more positive attitude toward ESPKs than others who had not heard about ESPKs. Participants shared their opinions about possible prejudices and obstacles to accepting ESPKs. Cost and availability were the most frequent responses, followed by, in this order: piano quality, spatial confusion and the difficulty with adjustment, the difficulty of breaking standard convention, cheating, limited space, and impartiality. This study showed the importance of education in not just explaining the existence of ESPKs, but also in providing specific information about the advantages of reducing risk, structural features of ESPKs and expected adaptation time. Changing keyboard size is a logical and ethical response to the challenges of small handed pianists. It will take more time to be accepted by the community of pianists. Cost and availability are also significant obstacles for individual players, especially for students. Therefore, schools providing ESPKs to their students with appropriate health education is the most efficient way to inform them of its advantages and to change their perceptions.

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<sup>45</sup> Boyle, 2015.

APPENDIX A  
IRB APPROVAL LETTER 2014



A green light to greatness.

THE OFFICE OF RESEARCH INTEGRITY AND COMPLIANCE

April 21, 2014

Supervising Investigator: Dr. Kris Chesky  
Student Investigator: Youjoo Son  
Department of Music  
University of North Texas

RE: Human Subjects Application No. 14-158

Dear Dr. Chesky:

In accordance with 45 CFR Part 46 Section 46.101, your study titled "Awareness and Attitude of Professional Keyboard Players towards Small Size Keyboards" has been determined to qualify for an exemption from further review by the UNT Institutional Review Board (IRB).

Enclosed is the consent document with stamped IRB approval. Please copy and **use this form only** for your study subjects.

No changes may be made to your study's procedures or forms without prior written approval from the UNT IRB. Please contact Shelia Bourns, Research Compliance Analyst, ext. 2018, if you wish to make any such changes. Any changes to your procedures or forms after three years will require completion of a new IRB application.

We wish you success with your study.

Sincerely,

Patricia L. Kaminski, Ph.D.  
Associate Professor  
Chair, Institutional Review Board

PK:sb

APPENDIX B  
INFORMED CONSENT LETTER

# University of North Texas Institutional Review Board

## Informed Consent Form

Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the purpose, benefits and risks of the study and how it will be conducted.

**Title of Study:** Awareness and attitude of professional keyboard players towards small size keyboards

**Student Investigator:** Youjoo Son, University of North Texas (UNT) Department of Music

**Supervising Investigator:** Dr. Kris Chesky

**Purpose of the Study:** You are being asked to participate in a research study, which involves investigating understand levels of awareness, knowledge of, and attitudes of professional keyboard players toward small size keyboards.

**Study Procedures:** You will be asked to fill out a 2-sided survey sheet. It will take about 10-15 minutes of your time

**Foreseeable Risks:** No foreseeable risks are involved in this study.

**Benefits to the Subjects or Others:** This study is not expected to be of any direct benefit to you, but we hope to learn more about awareness levels of small keyboards and attitude towards it. The results of this study may increase the interests about narrower piano keyboards and its availability. It may promote use of small keyboards among other colleges or universities, and that leads to prevent potential hand injury of small handed pianists.

**Compensation for Participants:** None

**Procedures for Maintaining Confidentiality of Research Records:** The subjects' personally identifiable information will not be collected. The subjects will be represented as numbers on any graphs, charts, or visual representation of data. The confidentiality of your individual information will be maintained in any publications or presentations regarding this study.

**Questions about the Study:** If you have any questions about the study, you may contact Youjoo Son at [yson09072@gmail.com](mailto:yson09072@gmail.com) or Dr. Kris Chesky at [kris.chesky@unt.edu](mailto:kris.chesky@unt.edu)

**Review for the Protection of Participants:** This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 with any questions regarding the rights of research subjects.

**Research Participants' Rights:**

Your signature below indicates that you have read or have had read to you all of the above and that you confirm all of the following:

- Micah Bowling has explained the study to you and answered all of your questions. You have been told the possible benefits and the potential risks and/or discomforts of the study.
- You understand that you do not have to take part in this study, and your refusal to participate or your decision to withdraw will involve no



penalty or loss of rights or benefits. The study personnel may choose to stop your participation at any time.

· Your decision whether to participate or to withdraw from the study will have no effect on your grade or standing in any course.

· You understand why the study is being conducted and how it will be performed.

· You understand your rights as a research participant and you voluntarily consent to participate in this study.

· You have been told you will receive a copy of this form.

\_\_\_\_\_ Printed Name of Participant

\_\_\_\_\_ Signature of Participant \_\_\_\_\_ Date

**For the Student Investigator or Designee:**

I certify that I have reviewed the contents of this form with the subject signing above. I have explained the possible benefits and the potential risks and/or discomforts of the study. It is my opinion that the participant understood the explanation.

\_\_\_\_\_ Signature of Student Investigator \_\_\_\_\_ Date

APPENDIX C  
UNT QUESTIONNAIRE

Age: \_\_\_\_\_ Gender: M/F Country of Origin: \_\_\_\_\_ Years playing piano: \_\_\_\_\_Yrs.

Do you teach piano lessons? Yes / No Degree sought (circle): Bachelor / Master / DMA / Others\_\_\_\_\_

For the following questions, mark your response with a vertical line to indicate your answer.

1. Piano players at UNT experience hand, finger, or wrist pain.

*Do not agree* \_\_\_\_\_ *Agree*

2. How much does pianists' hand size influence pain?

*Not at all* \_\_\_\_\_ *Very much*

3. Do you select repertoire based on your hand size?

*Not at all* \_\_\_\_\_ *Very much*

4. Estimate your hand size

*Small* \_\_\_\_\_ *Large*

5. Do you wish your hand size was different?

*Smaller* \_\_\_\_\_ *Larger*  
*Same*

6. Does hand size influence choices of piano repertoire?

*Not at all* \_\_\_\_\_ *Very much*

7. Are you familiar with pianos that have narrower piano keys?

*Not at all* \_\_\_\_\_ *Very much*

8. Have you seen a piano with narrower piano keys? Yes / No 8b. Have you tried one? Yes / No

9. Are you interested in learning more about pianos with narrower keys?

*Not at all* \_\_\_\_\_ *Very much*

10. Piano students should know about pianos with narrower keys.

*Do not agree* \_\_\_\_\_ *Agree*

11. Music departments in colleges or universities should offer pianos with narrower keys for their students.

*Do not agree* \_\_\_\_\_ *Agree*

12. Using pianos with narrower keys is a trick.

*Do not agree* \_\_\_\_\_ *Agree*

13. Generally, men have bigger hands than woman.

*Do not agree* \_\_\_\_\_ *Agree*

14. Hand size is related to race and ethnicity.

*Do not agree* \_\_\_\_\_ *Agree*

15. You are interested in trying narrower piano keyboards.

*Do not agree* \_\_\_\_\_ *Agree*

16. Piano key width has changed over time.

*Do not agree* \_\_\_\_\_ *Agree*

17. Most piano music composed between 1750 and 1850 (Mozart, Beethoven, Schubert, Chopin, Schumann, and Liszt included) was written using pianos with narrower keys compared to contemporary pianos.

*Do not agree* \_\_\_\_\_ *Agree*

18. Are you interested in learning more about the widths of piano keys?

*Not at all*

---

*Very much*

19. Some music departments offer pianos with narrower keys to their students.

*Do not agree*

---

*Agree*

20. Competitions should allow competitors the option of using pianos with narrower keys.

*Do not agree*

---

*Agree*

21. Using narrower keys may reduce hand tension, pain and injury among small-handed pianists.

*Do not agree*

---

*Agree*

22. Are you interested in learning more about the health benefits of narrower keys?

*Not at all*

---

*Very much*

23. Open your hand as wide as possible and place it down on the right edge of this paper so that you can mark the distance from the outside edge of your thumb to the outside edge of your pinky. Align your thumb with the bottom end of the line.



APPENDIX D

IRB APPROVAL LETTER 2017



UNIVERSITY OF NORTH TEXAS  
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THE OFFICE OF RESEARCH INTEGRITY AND COMPLIANCE

June 30, 2017

Dr. Kris Chesky  
Student Investigator: Youjoo Son  
Department of Music  
University of North Texas

Re: Human Subjects Application No. 17-202

Dear Dr. Chesky:

As permitted by federal law and regulations governing the use of human subjects in research projects (45 CFR 46), the UNT Institutional Review Board has reviewed your proposed project titled "Assessing Perception and Attitude of Pianists toward Ergonomically Scaled Piano Keyboards (ESPK): Raising Awareness about ESPK and Evaluating Attitude Change through an Educational Survey." The risks inherent in this research are minimal, and the potential benefits to the subject outweigh those risks. The submitted protocol is hereby approved for the use of human subjects in this study. **Federal Policy 45 CFR 46.109(c) stipulates that IRB approval is for one year only, June 30, 2017 to June 29, 2018.**

Enclosed are the consent documents with stamped IRB approval. Please copy and **use this form only** for your study subjects.

It is your responsibility according to U.S. Department of Health and Human Services regulations to submit annual and terminal progress reports to the IRB for this project. The IRB must also review this project prior to any modifications. **If continuing review is not granted before June 29, 2018, IRB approval of this research expires on that date.**

Please contact The Office of Research Integrity and Compliance at 940-565-4643, if you wish to make changes or need additional information.

Sincerely,

Chad Trulson, Ph.D.  
Professor  
Chair, Institutional Review Board

CT:jm

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1155 Union Circle, #310979 Denton, Texas 76203-5017 TEL: 940.369.4643 FAX: 940.565.4277  
TTY: 940.369.8652 <http://research.unt.edu>

APPENDIX E  
ONLINE BASLINE QUESTIONNAIRE



## Purpose statement

The purpose of this study is to assess the perception and attitude of pianists toward Ergonomically Scaled Piano Keyboards (ESPK), and to evaluate attitude change through an educational survey.

## Consent form

### University of North Texas Institutional Review Board

#### **Informed Consent Form**

Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the purpose, benefits, and risks of the study, and how it will be conducted.

**Title of Study:** Assessing perception and attitude of pianists toward Ergonomically Scaled Piano Keyboards (ESPK): Raising awareness about ESPK and evaluating attitude change through an educational survey.

**Student Investigator:** Youjoo Son, University of North Texas (UNT) Department of Music.

**Supervising Investigator:** Dr. Kris Chesky, University of North Texas: Texas Center for Music and Medicine - Director of Education and Research

**Purpose of the Study:** You are being asked to participate in a research study that involves assessing perception and attitude of pianists toward narrower keyboards, and evaluating attitude changes through an educational survey and intervention.

**Study Procedures:** You will be asked to provide information about your musical background, awareness, and attitudes towards narrower keyboards. Additionally, demographic measures will be taken to establish the diversity of subjects through an online survey. It will take about 10-15 minutes of your time.

**Foreseeable Risks:** There are not foreseeable risks involved with this study.

**Compensation:** None

#### **Procedures for Maintaining Confidentiality of Research Records:**

Confidentiality will be maintained to the degree possible given the technology and practices used by the online survey company. Your participation in this online survey involves risks to confidentiality similar to a person's everyday use of the internet.

**Questions about the Study:** If you have any questions about the study, you may contact [Yujoo Son](mailto:Yujoo.Son@unt.edu) at [yson09072@gmail.com](mailto:yson09072@gmail.com) or [Dr. Kris Chesky](mailto:kris.chesky@unt.edu) at [kris.chesky@unt.edu](mailto:kris.chesky@unt.edu)

**Review for the Protection of Participants:** This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-4643 with any questions regarding the rights of research subjects.

**Research Participants' Rights:**

By agreeing below, you indicate that you have read or have had read to you all of the above and that you confirm all of the following:

- The study has been explained to you. You have been told the possible benefits and the potential risks and/or discomforts of the study.
- You understand that you do not have to take part in this study, and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your participation at any time.
- Your decision whether or not to participate or to withdraw from the study will have no effect on your grade or standing.
- You understand why this study is being conducted and how it will be performed.
- You understand your rights as a research participant and you voluntarily consent to participate in this study.
- You must be 18 years of age or older to participate in this study.

- I understand and agree with the consent form above, and am 18 years of age or older.
- [Click here to exit the survey](#)

## Demographics

### Age

years old

### Gender

- Male
- Female

### Ethnicity/Race

- African-American
- Asian
- Caucasian
- Hispanic

Other

How many years have you been playing piano?

years

How many hours do you teach piano per week?

hours per week

Are you a piano faculty in college or university?

- Yes  
 No

What is the highest music degree you have completed? If currently enrolled, highest degree received.

- High school graduate. I am currently an undergraduate student of music school.  
 Bachelor  
 Master  
 DMA  
 Other

## Hand size measurement and desire hand size

What is the best description of your maximum hand span?

- I can play the interval of a 6th with my thumb and 5th finger without depressing neighboring keys, and can reach up to a 7th.  
 I can play the interval of a 7th with my thumb and 5th finger without depressing neighboring keys, and can reach up to a octave  
 I can play the interval of a octave with my thumb and 5th finger without depressing neighboring keys, and can reach up to a 9th.  
 I can play the interval of a 9th with my thumb and 5th finger without depressing neighboring keys, and can reach up to a 10th.

I can play the interval of a 10th with my thumb and 5th finger without depressing neighboring keys, and can reach up to a 11th.

- I can play the interval of a 11th with my thumb and 5th finger without depressing neighboring keys, and can reach up to a 12th.

While sustaining an octave built on C with my right hand, my index finger can depress the E flat without tilting my hand to the side or depressing neighboring keys.

- Yes  
 No

Do you wish to have a different hand size?

- Yes, larger hands.  
 Yes, smaller hands.  
 No, I am satisfied with the size of my hands.

How much larger do you wish for your hands to be?



### Hand pain and hand size-related problem

Have you ever had tension, pain, or an uncomfortable feeling in your fingers, hands or wrists when you practice the piano?

- Yes  
 No

How often do you have that tension, pain, or an uncomfortable feeling during the practice?



Click to indicate your response

Have you ever had a problem playing certain chords or passages because of your hand size?

- Yes
- No

Do you think hand size has an influence on choosing repertoire?

Not at all

Completely

0

100

Click to indicate your response

## Awareness

Did you know piano keyboards with narrower keys are available for pianists with a small hand span to play?

- Yes
- No

Have you ever seen a piano keyboard with narrower keys?

- Yes
- No

Have you ever tried a piano keyboard with narrower keys?

- Yes
- No

Some music departments offer pianos with narrower keys to their students.



Some competitions allow using pianos with narrower keys along with modern pianos for their competitors.



### Knowledge

Men have larger hand spans than women in general.



Hand size is related to race and ethnicity.



Hand size has an influence on the pain of fingers, wrists or hands of pianists.

Do not agree Totally agree

0 100

Click to indicate your response

Piano key width (different from numbers of keys) has been continually changed from its invented time.

Do not agree Totally agree

0 100

Click to indicate your agreement degree

Most music composed between 1750 and 1850 (Mozart 1756-1791, Beethoven 1770-1827, Schubert 1797-1828, Chopin 1810-1849, Schumann 1810-1856, and Liszt 1811-1886 included) was composed on instruments with narrower keyboards.

Do not agree Totally agree

0 100

Click to indicate your agreement degree

Using narrower piano keyboards for pianists with a small hand span can reduce hand tension, pain, and injury.

Do not agree Totally agree

0 100

Click to indicate your agreement degree

## Interests and attitude

Are you interested in learning more about narrower piano keyboards options that are available today?



Are you interested in learning more about the changes of the historical keyboard key widths?



Are you interested in learning more about the benefits of playing narrower piano keyboards?



Do you think piano students should know about narrower piano keyboards?





response

Do you think music departments at colleges or universities should have narrower piano keyboards for their students?

Not at all Completely

0 100

Click to indicate your response

Do you think that performing on narrower keyboards is a form of "cheating?"

Not at all Completely

0 100

Click to indicate your response

## Education intervention

### Educational Intervention

Please read this part and do not go back to previous questions.

\* The average hand span of a male pianist is 1 inch (2.5 cm) greater than that of a female. Females have 15% smaller hands than males on average. (Sakai, 2008)

\* Hand size is very much related to race and ethnicity. The hand span of German pianists is significantly larger than that of Japanese pianists. ( Sakai, 2008) Indian women's hand span is 0.9 inches smaller than American women's, 0.92 inches smaller than British women's, and 0.99 inches smaller than West Indian women's. (Nag, 2003)

\* Piano key width has been continually changed from its invented time. (Sakid, 2008)

\* Pianists with a small hand span have more pain and tension than pianists with a large hand span, and small hands are a significant risk factor. (Sakai, 2008)

\* Upper extremity musculoskeletal problems among keyboard instrumentalists were found to have a significantly higher prevalence among females. (Pak, 2000)

\* Small-handed pianists who are using a narrower keyboard report how much easier and more enjoyable piano playing is on a narrower keyboard, the dramatic reduction in time spent overcoming technical difficulties and the greater choice of available repertoire. (Rhonda Boyle, 2012)

Recent trends:

\* 7/8, 15/16 sizes of Ergonomically Scaled Piano Keyboards (ESPK, small sized keyboard) are available.

\* Several manufacturers including Steinbuhler & Co and the Charles Walter Piano Company in the United States, Laukhuff Keyboards in Germany, and Kawai in Australia are making narrower piano keyboards .

\* Ten universities in the United States, in Texas, North Carolina, Nebraska, Minnesota, Wisconsin, Oklahoma, and Ohio are now using ESPKs for teaching, performing, and researching.

\* Since 2014, the Dallas International Piano Competition has offered these options to their competitors.

\* In Australia, the Australian Music Examinations Board (AMEB) stated that they had no objection to the use of piano keyboards of different sizes for examination.

I read all information above, and I will not go back to previous questions.

**Post questions**

How much has your attitude changed about learning narrower piano keyboards options that are available today? Are you interested?

Not at all Very much

0 100

Click to indicate your interest scale

How do you think about piano students knowing narrower piano keyboards now? Do you think they should know about narrower piano keyboards?

Not at all Very much

0 100

Click to indicate your response

How do you think about music departments at colleges or universities having narrower piano keyboards for their students now? Do you think they should have narrower piano keyboards?

Not at all Very much

0 100

Click to indicate your response

How do you think about international competitions allowing ESPK (Ergonomically Scaled Piano Keyboards) as an option for their competitors now? Do you think they should allow using ESPK along with modern pianos for their competitors?

Not at all Very much

0 100

Click to indicate your response

Are you interested in trying narrower piano keyboards now?

Not at all Very Interested

0 100

Click to indicate your interest scale

What is your attitude about narrower keyboards now? Do you think that performing on narrower keyboards is a form of "cheating?"



### Opinion

What are the possible obstacles or prejudices in giving options of narrower piano keyboards to pianists, students, and to the public?

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