The 7/8 Piano Keyboard: An Attractive Alternative for Small-Handed Players

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Brenda Wristen[1] and M. Susan Hallbeck[1]

Abstract

This study examines whether the use of a 7/8 keyboard contributes to the physical ease of small-handed pianists in comparison to the conventional piano keyboard. A secondary research question focuses on the progression of physical ease in making the transition from one keyboard to the other. For the purposes of this study, the authors stipulated having a hand span of 8 in. or less as defining a "small-handed" pianist. Objective data measures were obtained through the use of surface electromyography (muscle activity measurement) and electrogoniometry (angle measurement). A questionnaire instrument was also used to examine the perception of participants as they experienced playing the 7/8-size piano keyboard in direct comparison with the conventional keyboard. Although objective data findings from this study are somewhat ambiguous, it is clear from the questionnaires that the majority of small-handed participants preferred the 7/8-size keyboard over the conventional one.

Keywords

7/8 Piano, small hands, hand size, keyboard, piano , ergonomics

Small-handed pianists encounter many technical problems stemming directly from the size of the full-size keyboard. Hand size can become a major barrier to success for pianists. Many other musical instruments, especially stringed instruments, are available in a variety of sizes, such as 1/2, 3/4, or 7/8 scale, for pedagogical reasons. Instrument modifications have been made to promote efficient bodily interface with standard instrument designs through adaptations such as posts and stands to support the weight of the instrument, chin rests for string instruments to maintain the neck in a more neutral position, and other basic improvements. This awareness of the ergonomics of instrument design has been accompanied by an interest in developing healthy seating to reduce static loading on body tissues (Norris, 1993). Instrument adaptation to fit the needs of players with special needs has also been of interest in the past few years. For example, Snedeker (2005) described several instrument designs for this purpose, including a saxophone adapted for a one-handed player, an air-powered trumpet and pedal trumpet for a trumpeter suffering from paralysis, a reverse trumpet that could be held with the right hand (trumpets are normally held with the left hand), a recorder for a player with osteoarthritis, a finger-guided tuba for a player who could not maintain lateral control of his fingers, and a drum set pedal adapted for an amputee.

The piano, on the other hand, has remained essentially unchanged since it arrived at its present form of development in the late 19th century. The width of each individual key on the piano is actually not standardized. Instead, it is the overall length of the keyboard that determines the width of the keys, with the overall keyboard length divided equally among keys. Different piano manufacturers produce keyboards of varying lengths. Older Steinway and Baldwin pianos measure 48 in. Newer Steinways are 48.375 in. long, and Yamaha piano keyboards are about 48.25 in. long, thus requiring slightly wider keys spread over the length of the keyboard. If there has been a change in the overall length of the piano keyboard in the past 50 years, it has been toward an increase in size rather than a decrease.

Up to the present day, small-handed pianists have often been dedicated amateurs instead of professional pianists (Wristen & Deahl, 2003). Articles addressing small-handed pianists have primarily focused on suggesting adaptive strategies for small-handed pianists. However, with the greater numbers of women pursuing professional degrees in piano performance and pedagogy and wider professional

[1]University of Nebraska–Lincoln

Corresponding Author:
Brenda Wristen, University of Nebraska–Lincoln, 343 Westbrook Music Bldg., Lincoln, NE 68588-0100
Email: bwristen@unlnotes.unl.edu

involvement by pianists from the Pacific Rim, there are more small-handed pianists playing at all levels of abilities. Wagner (1988) has developed normative data on the anthropometry (measurements) of pianists' hands, documenting a wide range of variation in hand measurements among pianists. Although the overall size of the hand span undeniably affects piano playing, it is not the only hand dimension that influences ease of hand use at the keyboard. The way the fingers are aligned with the rest of the hand, the distance between the metacarpal bones of the hand, the length of each digit, and the amount of skin webbing between the fingers all affect the biomechanical function of the hand, not to mention flexibility and range of motion at all the joints. For example, Yoshimura, Paul, Aerts, and Chesky (2006) found a strong correlation between small span between Digits 3 and 4 in the right hand of 35 piano performance majors at the University of North Texas and pain associated with piano playing. Currently, there is increased interest in whether or not small hand size may be identified as a risk factor for potential development of playing-related injuries.

In addition to the wide individual variations in hand anthropometrics, hand sizes widely vary according to gender and ethnicity. Wagner (1988) found that average hand span (distance from tip of thumb to tip of fifth finger) for both the right and left hands in male German pianists was 227 mm. The comparable dimension among 105 German female pianists was found to be 207 mm. When Sakai, Liu, Su, Bishop, and An (2006) measured 100 Japanese pianists (including both male and female), they found that the average overall span of the right hand was only 202 mm. One might reasonably surmise that if data for Japanese female pianists had been separated from males, this average hand span would have been even smaller.

The 7/8-size piano keyboard, which has gained attention during the past 5 years or so, is gaining recognition as a possible alternative standard size for small-handed pianists. The 7/8 keyboard (also known as the D.S. standard) is the most common size among several adaptive-size piano keyboards for pianists with small hands manufactured by Steinbuhler & Company (http://www.steinbuhler.com) and can be fitted into a grand piano in place of the full-size keyboard. The 7/8 keyboard has the same number and configuration of keys as the full-size piano keyboard. Its smaller scale results in an octave that is roughly one white key width shorter than the conventional keyboard. Leone (2003) offered anecdotal evidence that small-handed players had great success with the 7/8-size keyboard during a trial at Southern Methodist University. In light of the anecdotal evidence offered by Leone, the purpose of this study is to examine the 7/8 keyboard as compared to the conventional-size keyboard with regard to muscular and joint activity and perceived ease of use by small-handed pianists.

Regardless of hand size, piano players are all affected by the workload dictates of the instrument itself. For centuries, pianists modeled their techniques after that of famous performers and/or piano teachers. Scientific inquiry has only recently been employed to study motion patterns that define piano technique more objectively. Ortmann (1929/1962), a pianist rather than a scientist, attempted to accurately observe movements made at the piano using strategies such as attaching light-emitting diodes to the fingers and capturing the motions made by pianists on photo-sensitive paper that had been placed against the fallboard of the piano. He, like Matthay (1903) and Breithaupt (1909) before him, attempted to apply knowledge of human anatomy and physics to try to describe universal principles of piano technique. Ortmann's seminal treatise, *The Physiological Mechanics of Piano Technique*, was not well received by the music community of the early 20th century, who believed that by adding objectivity to observation and description of piano technique Ortmann was negating the artistic elements of piano playing. However, as science and medicine steadily advanced through the 20th century, using rigorous and scientific means to study piano technique became more palatable within the music community, especially as teachers began to perceive that such research was not a direct threat to their livelihoods. Particularly since the emergence of performing arts medicine as a distinct area of specialization in the 1980s, the music world has become increasingly aware of the occupational injuries suffered by musicians, and interest has turned toward how these injuries might be prevented. The medical sciences have had an increasing impact on the study of musicians and their bodies over the past decade or so, as have the sciences of ergonomics (which considers the interplay of human capabilities and work demands) and biomechanics (the application of physics and engineering principles to the human body).

Although a few studies (Meinke, 1995) have attempted to describe work performed at the piano from a broad, global perspective, until very recently most scientific studies of motions made in piano playing have examined one isolated part of the playing arm. Several descriptive studies of wrist motions (An, Hillberry, Ryu, & Bejjani, 1993; Chung, Ryu, Ohnishi, Rowen, & Headrich, 1992) made during the performance of various playing tasks have been conducted. Forces measured in the fingers and/or finger tendons during playing of a given task at the piano and developing paradigms to minimize these forces have also been research focuses (Harding, Brandt, & Hillberry, 1989; Hillberry, Wolf, Hiner, Keane, & Brandt, 1993), as has examination of hand "position" during playing (Bejjani et al., 1989). Researchers have also quantified forces that are generated by the fingers on the piano keys and considered the impact of these forces on the finger and hand (Parlitz, Peschel, & Altermuller, 1998). Unfortunately, information from these studies of isolated parts of the body is difficult to practically apply given the active interaction of all parts of the torso and upper limb. Moreover, excerpts selected for performance in these studies tend to be extremely short and isolated, thereby not accounting for the potential fatigue effect of playing the piano over time.

Researchers' attention has only of late been directed toward quantifying motion more globally, in a manner that considers the cooperative work accomplished by all involved parts of the anatomy. Shan, Visentin, and Schultz (2004) used motion capture technology in conjunction with surface electromyography (sEMG; which measures work done by muscles) and biomechanical modeling to study motions made by violinists while playing. Their findings demonstrated how information from multiple modes of assessment including sEMG, high-speed motion capture technology, internal load analysis, and biomechanical modeling could be integrated to provide a fuller understanding of violinists' motions. Wristen, Evans, and Stergiou (2006) conducted a case study using high-speed three-dimensional motion analysis to quantify and describe motions made by a pianist when performing two different playing tasks, one that had been practiced and one that had not. Segments in the torso and upper limb were marked using reflective balls, with larger segments marked using balls of larger diameter and fingers marked with small 2 mm markers, often used for capturing motion in small facial muscles**.** A six camera digital infrared optoelectronic system (Motion Analysis, Inc.) sampling at 120 Hz was used to capture the pianist's motions during performance, allowing for examination of the efficiency of motions observed. Sakai et al. (2006) used a similar process to quantify and describe the hand spans and joint angles of five professional and five amateur pianists during performance. Ferrario, Macri, Biffi, Pollice, and Sforza (2007) also used motion capture technology to analyze and compare finger and hand movement patterns in 19 pianists of varying levels of experience playing the same musical excerpt, employing multiple markers per finger.

The purpose of this study is to examine expert and novice pianists' experience, in terms of comfort, while playing on a full-size piano keyboard (Steinway Model "L") and a 7/8-size piano keyboard (invented and manufactured by Steinbuhler & Company) and transitioning from one piano to another. On the full-size keyboard an octave measures 16.51 cm, and the octave on the 7/8-size keyboard measures 14.07 cm, a difference that is easy to discern visually (Figure 1). Both of the keyboards were tuned and regulated for touch control by a registered piano technician to minimize variables other than size. To ensure that data were relevant and meaningful to the "real-world" experience of pianists, the study made use of both objective data measurement and a self-reported comfort scale and questionnaire.

Method

A total of 24 small-handed participants were recruited, with small handedness being defined as having a full-hand span from tip of fifth finger to thumb of 8 in. (203 mm) or less. After obtaining informed consent in compliance with institutional research board guidelines, the 24 participants were divided into "expert" and "novice" groups based on ability to play the musical excerpts used in this study. There were 10 novice-level pianists and 14 experts. One of the experts was excluded for noncompliance with the research procedure. According to questionnaires completed by the participants, surprisingly only 4 out of 24 total participants indicated that they had previously suffered a music-related injury, although these same 4 participants had suffered multiple injuries in the past. The injuries that were identified included three instances of tendonitis believed to have been caused by playing octaves and/or large blocked chords, overextension of the left hand thumb, crushed nails on the thumb and fifth finger from impacting keys, and a "collapsing" fifth finger with joint damage associated with the impact of hitting the keys. It is likely that small hand size was a contributing factor in these types of injuries, as they would all tend to result from playing with the hand in an extended position, though demonstration of causality in these cases is beyond the scope of the present study. One additional participant, though indicating that he or she had not suffered from a piano-related injury, did note that his or her left hand got "sore" if he or she played for too long of a duration. All participants were healthy and pain free during their participation in the study.

The experts were given a musical excerpt to practice consisting of the first 34 measures of the piano part from the opening of the Tchaikovsky Piano Concerto in B flat (Figure 2). The novices played a I-IV-I-V-I cadential chord progression consisting of octaves filled in with chord tones (Figure 3) and two octave, hands-together arpeggios in the keys of C, E flat, and B flat major at quarter note equal to mm. 144. One to two weeks prior to data collection, each pianist signed informed consent consistent with institutional research guidelines and was randomly assigned to either the 7/8 or the conventional keyboard. Participants were allowed to practice up to a maximum of 10 hours and kept practice logs to confirm this. All participants were instructed to practice the excerpt *only* on their assigned keyboard.

During data collection, each participant was wired with surface electrodes to measure muscle activity via sEMG. Muscles selected for measurement were the masseter, trapezius, the hand and finger flexors, and the hand and finger extensors. The electrodes measured the electrical impulses generated by muscular activity on both sides of the body as the pianists played through the assigned excerpt. Raw sEMG data were then converted to newtons, a measure of force, to assess participants' muscle exertion while working on the conventional piano keyboard compared to the 7/8 keyboard. Electrogoniometers, which measure angles, were also attached to measure hand span and lateral and vertical range of motion at the wrist during playing**.**

Each participant first played three trials of the excerpt on the instrument to which he or she was assigned (referred to as the "practice" keyboard), either the 7/8 or the conventional keyboard, and was allowed to select his or her "best trial." Trials were recorded, and the "best trial" was confirmed by an

Figure 1. D octave on the full-size (at left) and 7/8-size (at right) piano keyboard ($p < .05$)

expert piano evaluator based on criteria such as note accuracy, pulse continuity, and tempo. The participant then moved to the keyboard on which he or she did not practice the excerpt (the "unfamiliar" keyboard) to measure activity of muscles and joints as the participant adapted to the other keyboard. Seven trials were completed at this "unfamiliar" keyboard to understand how easy or difficult it was for participants to transition between the two different keyboard sizes. For all trials, at both the practice and the unfamiliar keyboard, participants were asked to rate their "comfort level" on a Likert-type scale from 1 to 10. Participants then completed a questionnaire regarding their history and practice experience.

Results

Analysis of the full participant population uncovered several intriguing findings. Not surprisingly, participants exhibited very different levels of mastery with the assigned excerpt. Some were simply better prepared than others. In keeping with the difficulty of the two different excerpts, experts practiced more than the novices. Muscular activity (sEMG) measurement revealed a large degree of variation from one participant to the next in amount of activity in the various muscle groups. We also observed some clear findings with regard to participant groups. Experts used approximately 1.5 times more force with both flexor and extensor muscle groups in comparison to the novices. At face value, this might seem surprising given the general maxim that expertise gives rise to economy of motion (Niebel & Frievalds, 2003). However, this finding most likely directly relates to the differing demands of the excerpts performed for the study (Figures 2 and 3). The experts' excerpt was longer and employed fortissimo (loud) chords throughout, increasing the amount of force acting on the hand while it was fully extended.

With regard to keyboard size, on average, both experts and novices who practiced on the 7/8 keyboard used less muscular activity in comparison to those who practiced on the full-size keyboard, though this difference was surprisingly not shown to be statistically significant ($p < .05$). Novices who practiced on the full-size keyboard used roughly twice as much forearm extensor muscle force as those who practiced on the 7/8 keyboard, though again this difference was not shown to be statistically significant. Most surprisingly, muscle activity data revealed that participants experienced a slightly higher muscular activity in their extensor and flexor muscle groups while playing the 7/8-size keyboard than when playing the full-size piano (Figure 4). The extensors are the muscle tendon units that open the hand, whereas the flexors close the hand. Again, this finding may be a result of muscular bracing because of a lack of familiarity with the 7/8 keyboard, though more research would be required to show definitive cause. As anticipated, the masseter and trapezius muscles showed slightly lower muscular activity with the 7/8-size keyboard.

To examine each participant's transition to the unfamiliar instrument, the initial transitional trial was considered a baseline from which subsequent transitional trials were plotted to describe a transition "curve" (Figure 5). We hypothesized that self-reported comfort levels during transition trials would move steadily upward for participants encountering the 7/8 keyboard for the first time and would move downward on the conventional keyboard because of fatigue, as findings from our pilot study (Wristen, Jung, Wismer, & Hallbeck, 2006) demonstrated this effect very clearly. Only 7 of 13 experts' (1 of the 14 experts was excluded from the study) curves conformed to the hypothesis. However, *all* of the transition curves to the 7/8 keyboard conformed to the hypothesis, showing that those players who had practiced on the full-size keyboard became progressively more "comfortable" when allowed to play the challenging excerpt on the smaller keyboard. It was the transition curves to the full-size keyboard that did not cleanly conform to our hypothesis. With regard to the novices, 7 of 10 transition curves conformed to the hypothesis.

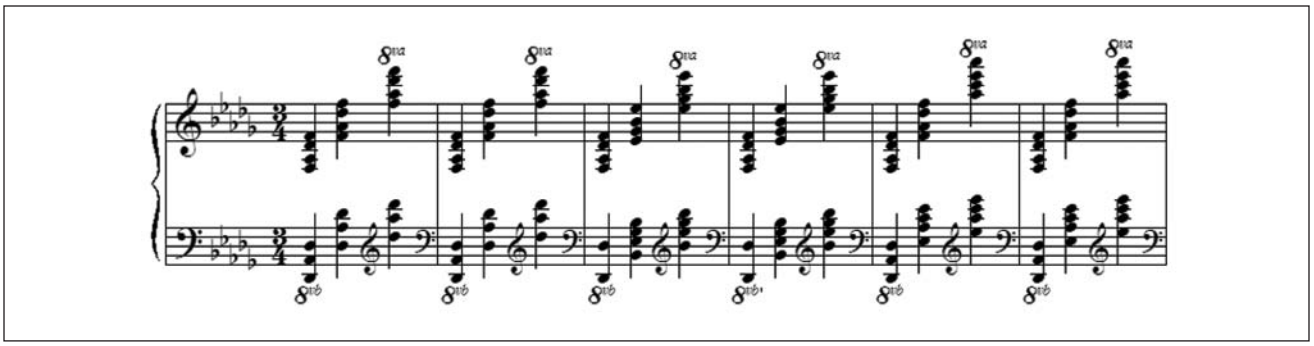

Figure 2. Sample taken from expert group excerpt, consisting of the opening of the Tchaikovsky Piano Concerto 1 in B-flat minor

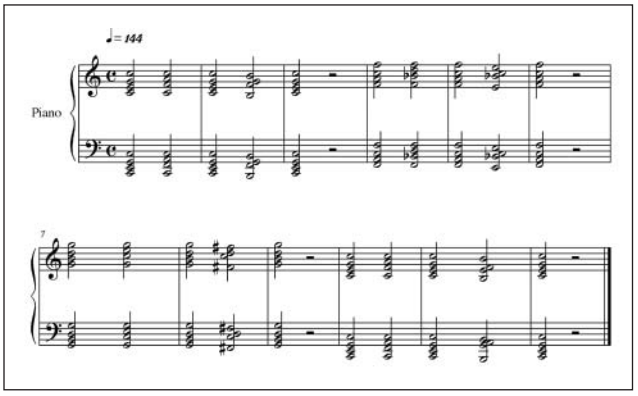

Figure 3. Chord progression as played by a novice group

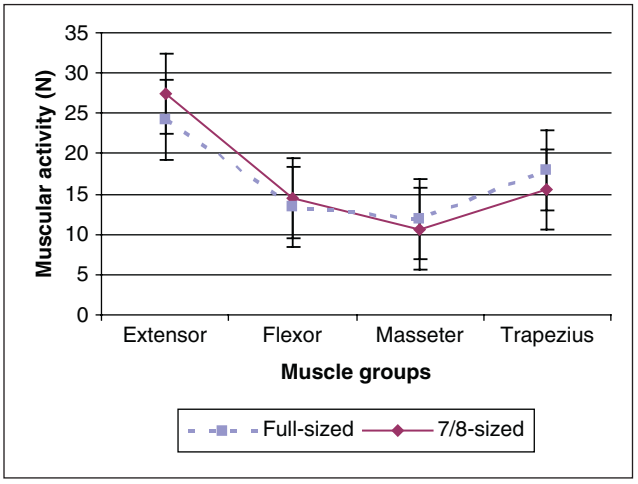

Figure 4. Muscle activity of four different muscle groups by keyboard size

Here, findings were mixed for both keyboards—no clearly delineated curve was observed. Among the novices, muscle activity values measured by sEMG at the conventional keyboard were generally higher or equivalent to forces used at the 7/8 keyboard, though these differences were not statistically significant. Anecdotally, the 7/8-size keyboard was rated 22% more comfortable to transition to than the full-size keyboard. The comfort ratings for the piano size by skill interaction (Figure 5) show that both experts and novices were far more comfortable with the 7/8-size keyboard. However, experts reported higher ratings of comfort on both the full-size and 7/8-size keyboard than did the novice pianists, which was expected given the experts' greater familiarity with the piano, regardless of the size of the keyboard. On average, the novice pianists were only 67% as comfortable as the expert pianists.

Participants were also given an opportunity to express their preference of keyboard size on the questionnaire. Of the 13 experts, 10 preferred the 7/8 keyboard, citing increased physical comfort. However, several expressed concerns regarding lack of availability of the 7/8 keyboard in other venues or difficulties with visual and tactile orientation on the 7/8 keyboard given the amount of practice time allowed in this study. Of the 3 who indicated preference for the conventional piano, 2 indicated that they felt more physically comfortable on the 7/8 and would likely prefer it given more time to adjust to the key size. Of the 10 novices, 6 preferred the 7/8 keyboard, again citing physical comfort, whereas 4 preferred the conventional piano because they were more accustomed to it.

Discussion

Although differences in muscular activities were observed when comparing the 7/8- and full-size keyboards, these were not shown to be statistically significant as discussed above, except in the masseter (jaw) and trapezius (shoulder/neck) muscle groups. Possible explanations for this lack of significant findings include the relatively small research population along with simple tactile unfamiliarity with the 7/8 keyboard. Participants may have used more force on the 7/8 keyboard than necessary because of their long-term experience of having to overexert themselves on the conventional keyboard, making the difference between the two keyboards too small to be significant. The finding of slightly higher muscular loads on the 7/8 keyboard for the flexors and extensors of the hand may be because of the need for players to constantly readjust the size of their

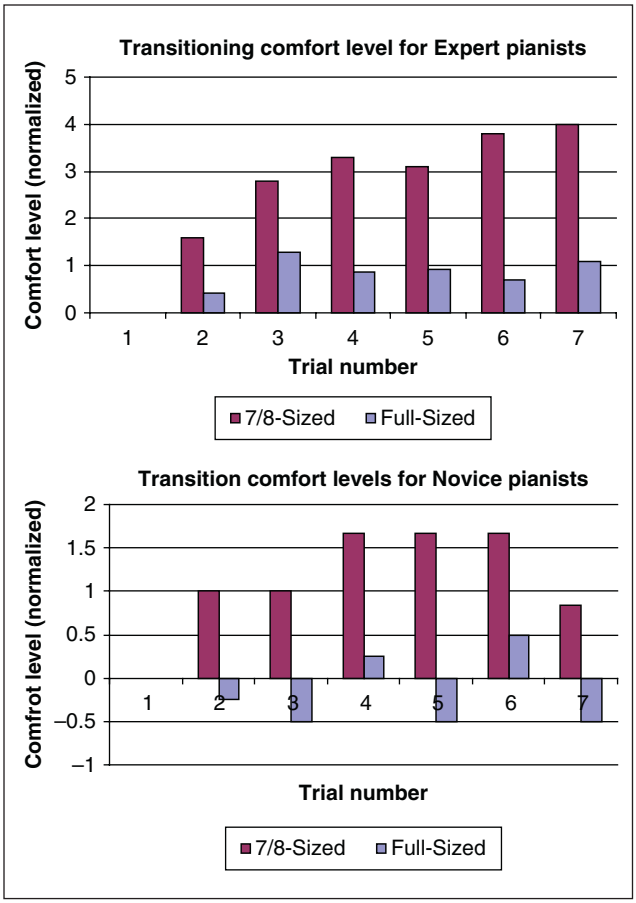

Figure 5. Transition curves of self-reported comfort levels of expert and novice pianists by keyboard size

hands (i.e., contract the hand to a smaller octave) to play the excerpt on the 7/8 keyboard, which may have resulted in higher muscle activity values. The overall lower level of muscular activity observed in the masseter and trapezius groups may signal a tendency toward more comfort at the 7/8 keyboard. Though these findings were not statistically significant, they point to an intriguing area for future research. The trapezius muscle group, which runs along the top of the shoulders and up into the neck, is prone to excess muscular tension and bracing. Similarly, the masseter muscle of the jaw is prone to excess muscular tension in response to either physical or emotional stress. Thus, the lower levels of muscle activity in the trapezius and masseter muscle groups may indicate a lower level of generalized mental "tension," or overall feeling of strain, at the 7/8 keyboard.

As noted, the transition curves to the 7/8 keyboard in the expert group demonstrated a steady increase in the level of comfort as perceived by participants. The transition curves to the full-size keyboards among experts showed the steady increase in "comfort" anticipated. It was the transition curves to the conventional keyboard where wide variance was noted. Some of the transition curves did decrease steadily, as predicted. However, some curves went up, then down sharply at the end of the trials, whereas other curves described a relatively flat line. One possible explanation for this effect is that because participants had been playing on a full-size keyboard their entire lives, they quickly reaccommodated themselves and thus reported feeling more comfortable sooner than anticipated. The lack of clear findings with regard to transition curves among novices is likely because of this group's overall lower level of expertise and "comfort" with the piano, regardless of keyboard size. It is also very important to note that these participants were asked to report how "comfortable" they were during the trials. There is evidence that participants factored in the musical accuracy along with their perceived physical comfort level in their self-reported ratings because these ratings did not correlate with sEMG data, which simply shows how hard muscles are working without regard to missed notes. The much higher "comfort" rating of the experts was predicted, considering the novices' overall lower level of motor facility and tactile command on both the full-size and 7/8-size keyboards when compared to the experts' abilities. Because the novice pianists have less experience, they are more uncomfortable in general when playing the piano.

On the written questionnaire, participants were given an opportunity to offer comments about their study experience with the 7/8 versus the conventional piano keyboard. Although the participants of this study did express a clear preference for the 7/8 keyboard, as discussed above, some expressed that playing the 7/8 keyboard was visually and physically disorienting. One way of ameliorating the visual and tactile disorientation noted by participants would be to practice a particular piece of repertoire *exclusively* on the 7/8 keyboard, obviating the need to switch back and forth between keyboard sizes. Other concerns included the lack of availability of 7/8 piano keyboards in performance venues. Even so, anecdotal evidence from the questionnaires shows a clear preference for the 7/8 keyboard among the majority of our participants. Selected anecdotal comments from expert-level participants are given in Table 1. The novice-level pianists expressed fewer comments regarding the differences they observed between the two keyboard sizes, as exemplified in Table 2.

Comments made by the participants during the transitional trials from the conventional keyboard to the 7/8 keyboard and vice versa are also illustrative, as they are indicative of subjective response as participants directly compared playing experiences on the two keyboard sizes. These included both expressions of delight on first encountering the 7/8-size keyboard and comments expressing some distress at switching back and forth between the 7/8 and full-size, conventional keyboard. Some of these comments made during the transition between instruments are summarized in Table 3. The majority of the small-handed participants in our study preferred the 7/8 keyboard using subjective measures.

Table 1. Expert Questionnaire Comments Regarding 7/8 Versus Conventional Piano Keyboard

Frankly, it has made me more sure of my ability, and I hold a bit of a grudge against pianists with larger hands that are sloppy/lazy or just don't seem to care. The 7/8 has liberated me and at the same time make me feel almost oppressed [*sic*] by the full size and those who scoff at the 7/8.
I . . . think that large pieces that require stretching the hand far and playing loud (like the excerpt) are much easier on the smaller instrument. I got really tired playing the excerpt on the normal piano.
The orientation [of the 7/8 keyboard] was so different I made mistakes and had hesitation.
[Playing two pianos was] . . . a totally new distance both physically and visually.
I would absolutely choose the 7/8 keyboard because I could play all of the octaves required of me. It's so nice to be able to play a 10th without rolling the chord. Also, it feels better and I can play stronger. On a conventional piano, I'm often grabbing chords and skating across the top of the notes, hitting in the cracks, etc.
I was never entirely physically comfortable with the excerpt on a conventional piano; practicing it caused fatigue that didn't resolve over time. I suspect it would have been much more comfortable on the 7/8 keyboard if used from the start.
The problem I encountered in adjusting to the 7/8 keyboard were body orientation to the new situation—how to keep my arm/hand at the correct angle to play octaves easily and accurately. Keeping my left hand shaped for an octave was a constant thought. When playing on the conventional keyboard I needed to leave out some notes in chords or "fake" the chords.
It surprised me how much I actually noticed the difference in keyboards. I could feel that I was using much more effort to play the excerpt on the regular keyboard. I also feel that people sometimes have a "suck it up" attitude toward small-handed pianists and I would love for someone to prove that it really is difficult for us sometimes. I feel a 7/8 keyboard would allow me to master a greater variety of repertoire.

Table 2. Novice Questionnaire Comments Regarding 7/8 Versus Conventional Piano Keyboard

Octaves are really hard to reach for people with small and/or inflexible hands. . . . Switching to the 7/8 piano is really hard[,] especially when trying to play something like a piece you know really well because the muscle-memory is off and you end up hitting wrong notes all the time.
Adjusting to the regular piano [after having practiced on the 7/8 keyboard] was more difficult than I would have thought.
The [chord progression] excerpt was a struggle [on] the conventional [piano] just to get the right fingers down *every time*. The octaves were a stretch and my hands did become sore after long periods of practice on the conventional keyboard.

Table 3. Comments Made by Study Participants in Transitioning Between Keyboards

Moving from Conventional to 7/8 Keyboard	Moving from 7/8 to Conventional Keyboard
You see it for 12 years one way, then see this!	Are these keys wider (than other conventional size instruments)?
This looks incredibly bizarre. This feels so odd.	It's hard!
Never in my life have I been able to reach a 10th! . . . My hand does not fit as usual. . . . It gets a little easier each time. . . . It is definitely getting more comfortable.	Are you sure this is not a larger than normal size piano? It feels enormous!
Wow! This is weird! It is very bizarre. I feel like it's a small world.	My goodness these [keys] are so big!
	The keys look huge! I don't like switching back and forth.

The few concerns regarding the playing experience of the 7/8 keyboard expressed by participants, as noted, above are likely a direct result of the research method of this limited study, which required players to perform an excerpt that they had practiced for only 10 hours on a keyboard they had never encountered before. A methodology that allowed all participants to practice in equal amounts on both 7/8 and conventional keyboards might show a more marked difference in sEMG measures. However, we were highly interested in the amount of time it might take to adjust to the 7/8 keyboard on encountering it for the first time. The transition curves to the 7/8 keyboard among expert pianists clearly show a steadily increasing rating of "comfort" over a period of 30 minutes playing time, leading us to conclude that at least some measure of tactile familiarity with the 7/8 keyboard can be gained in a relatively short period, particularly by expert-level pianists. Concern over how long it would take to adapt to the "feel" of the 7/8 keyboard is a particular hurdle in the minds of potential players, and widespread adoption of the 7/8 keyboard as an alternate standard size is not likely until pianists are reassured on this point.

Conclusions

Although the quantitative muscle activity (sEMG) data from this study do not demonstrate significant findings, 16 of 23 participants in this study indicated a preference for the 7/8-size keyboard on the questionnaire. Those

indicating a preference for the full-size keyboard did so based on practical concerns about widespread availability of the 7/8-size keyboard in performing venues.

The 7/8 piano keyboard may also prove beneficial for pedagogical purposes. When students begin playing instruments at a very young age (e.g., in Suzuki string programs), it is common practice to offer the children an instrument that is smaller to fit their physical dimensions. This is not the case with the piano, though more children study piano than perhaps any other instrument. Although no studies on children and the 7/8 piano keyboard have been published to date, it seems intuitive that offering children an instrument that fits their bodies would allow for quicker pedagogical progress on the instrument. Providing a more natural physical interface with the instrument would also likely help avoid ingraining unnecessary tension as children build technical skill.

Offering small-handed pianists a keyboard that fits a smaller hand rather than forcing all pianists to play the full-size, conventional piano keyboard is likely to result in greater physical ease and mastery at the instrument. One can envision a day when concert artists could walk into a concert hall and choose between sizes of piano keyboards. Such a sea change in the professional music world might open piano playing at the highest artistic echelons to small-handed pianists who have heretofore been impeded in their ability to build a professional performance career because of the many challenges of coping with the conventional-size keyboard (Wristen & Deahl, 2003).

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